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The Treatment of Cerebral Palsies*

From the Standpoint of the Physical Therapist

M. E. Pusitz, M.D., F.A.A.O.S.

Introduction

There is lack of cooperation between the various specialties in the treatment of cerebral palsy. The orthopedic surgeon has one view, the psychiatrist another, and the speech expert still another. All too frequently an item in treatment is considered the whole treatment, many excellent contributions being made but not being correlated. There is too much enthusiasm for this or that operation, the important fact being forgotten—that the nucleus in treatment is the very work which the physical therapist should be trained to execute. Yet nowhere in the entire literature is there a complete and comprehensive survey of the principles which should guide it.

Definition

Cerebral palsy is a lesion of the upper motor neurone, due to disease or injury affecting the cerebral motor centers. As a result there is loss of cerebral inhibition. It is not a paralysis at all.

Incidence

No accurate statistical survey has been made, but my own investigations have shown that there are more cases of cerebral palsy than there are of infantile paralysis. Many cases of cerebral palsy are not investigated, since some are looked upon as idiots and many are inmates in institutions. There are also many mild forms which go unrecognized and are considered due to rickets, scurvy or glandular disturbances. Due to confusion as to the condition itself, the family physician feels that nothing can be done, while the quack states that he can cure the condition. To the parents this means failure from both angles.

Etiology and Pathogenesis

Congenital lack of development of the pyramidal tract, or other portions of the central nervous system, may lead to atrophy or sclerosis of the lateral columns of the spinal cord, to large cerebral defects, to porencephaly or to hemorrhage. Congenital syphilis and intrauterine infections may be factors. These are serious to treat and unfortunately cannot be distinguished later in life from those occurring at birth.

The majority of cases are acquired. Trauma of the child's head because of prolonged labor, precipitate labor, forceps delivery, prolonged asphyxia at birth, contracted or malformed pelves, rigid soft parts, abnormal presentation, breech extraction or over-large fetal heads may give rise to intracranial hemorrhage. As a result there may occur chronic meningeal encephalitis, sclerosis, cysts, atrophies and porencephaly.

Those coming on later after birth may be caused by hemorrhage, embolism, endoarterial and periarterial changes, encephalitis, cerebral venous thrombosis and chronic meningitis. Anterior poliomyelitis may sometimes give

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rise to cerebral palsy which may or may not be combined with flaccid paralysis.

There is no cure for cerebral palsy. A destroyed nerve cell is never regenerated. Treatment is therefore palliative and resolves itself into the lessening of the muscle incoordination, which is the result of this upper motor neurone lesion with which we have to deal.

Muscle Coordination

Coordinated muscle function is a physiological mechanism, the functional unit of which is the reflex arc, composed of two or more neurones. Too much attention must not be paid to the psychic factor. Many of the activities which normals portray are no longer under the control of volition. Equilibrium, balance and posture are controlled through involuntary reflexes acting through the centers in the midbrain and cord. Even skilled movements, such as walking, running or dancing, although in the beginning brought about by volition, in the end become entirely reflex or involuntary. By cerebral control through the continued adjustment of certain sensory impulses to certain movements, there results the establishment of paths of least resistance, or reflex arcs. The important function of volition is in the correlation of stimuli, whether they be visual, auditory, sensory or proprioceptive, with certain definite movements.

The Neurone is the anatomical unit of the nervous system. It consists of a nerve cell and two sets of processes. The receiving set is composed of many fibers called dendrites. The sending set is a long single process called the axone. This may be of any length and is the main pathway along which the nerve impulse travels. The axone joins dendrites of another unit, but they are not in direct continuity. This interpolated junction area is called a synapse.

The Reflex Arc. Reflex action is the involutary production of activity in some peripheral tissue as a result of stimulation of afferent fibers. It may be accompanied with consciousness, as in the winking reflex, or it may be devoid of consciousness, as in the emptying of the gall bladder during digestion.

Unconditioned Reflexes. These are fixed reflexes with an inherited physiological mechanism. They may be simple, coordinated or convulsive:

1. *The simple reflex arc* must consist of at least two neurones, a sensory afferent neurone, which brings the impulse from the periphery to the spinal cord, and an efferent neurone, which sends out the motor impulse to the muscles from the spinal cord. The conversion of the sensory impulse into the motor one takes place in the nerve center. The sensory neurone has its cell in the dorsal ganglion of the posterior root or of the cranial nerves; the motor neurone has its cell in the anterior horn of the gray matter of the spinal cord or in the motor nucleus of a cranial nerve. An example of a simple reflex is the winking reflex which causes the orbicularis palpebrarum to contract.

2. *Coordinated Reflexes.* The sensory fibers coming into the spinal cord, via the posterior root, may not pass directly to the anterior horn cell but pass up the spinal cord, or higher. On the way up it may give off a number of collaterals, which in turn connect with anterior horn cells, or it may connect up with intermediate neurones, which in turn may make connections with any number of anterior horn cells. When this reflex mechanism is set into action there is contraction of groups of muscles and not of a single muscle. One afferent or sensory impulse may make connection with any number of motor units, or on the other hand many sensory pathways may link up with only one motor unit. These are mechanical situations, physiologically. It is true that a sensory impulse may pass all the way to the cerebrum and give rise to conscious sensation, but on its way up it may connect in this manner with many motor pathways through its collaterals, giving rise to involuntary reflexes as far as motion is concerned.

In a coordinated reflex a number of muscles will contract, as a result of stimulation, but the contractions are harmonious and result in an orderly movement. There is reciprocal function of agonists and antagonists. In experimental physiology the cerebral influence can be removed in the frog so that one has what is called a spinal animal. Stimulation of any part of the skin will give rise to movement which seems coordinated and purposeful, even without brain function. There is almost mechanical exactness for the same type of stimulation. If an irritant is placed on the skin, the animal will make a movement with its other leg as if to remove it. If the leg is pinched, the spinal animal will withdraw it.

The purposeful character of these move-

ments are, however, the automatic activity of a physiological mechanism. It would seem that there are certain paths which offer less resistance, and it is along these paths that the impulses travel from the skin to the cord and from the cord back to the muscle. These paths of lessened resistance are in part preformed and in part laid down by the repeated experience of the individual.

3. *Convulsive Reflexes.* Very intense sensory stimulation will cause an overflow of the reflex response into all the motor paths. The same effect is produced when the irritability of the central nervous system is heightened. For example, if a little strychnine is injected subcutaneously in the spinal frog, it is absorbed and makes the sensory area of the brain hyperirritable. A very mild stimulation of skin which otherwise would result in a coordinated reflex may now throw all the muscles into contraction. Since the extensors are stronger than the flexors, the animal's body becomes rigid in extension with stimulation. There is no longer orderly or purposeful movement. This is true in cerebral palsy. Coordinated reflexes no longer occur because of the hyperirritable state of the sensorium. As a result there is an overflow of reflex response into many motor channels, all at once, giving rise to incoordinated action.

Inhibition. Ransom has shown that unconditioned reflexes are not always fixed. Although the afferent impulse usually excites, under certain conditions it may inhibit. There is a continuous bombardment of the cord with incoming stimuli. The effect of a given stimulus depends upon the state of relative excitation or inhibition which prevails at that moment. Dependent upon this balance, there will be a flexor reflex or an extensor reflex.

Setschenow noted that if the upper end of the cut spinal cord in the spinal animal be irritated with crystals of sodium chloride, there will be inhibition of the spinal reflexes that usually follow stimulation of the skin. If the salt is washed away, then the usual coordinated reflexes occurs. This shows that it is an inhibition and not a destruction of the reflex mechanism. This is a physiological demonstration of the inhibiting stimuli which pass down the spinal cord from the brain. In fact, it plays an important role in the law of reciprocal innervation, as enunciated by Sherrington. For coordinated function, when the agonistic muscle is stimulated reflexly, there must be relaxation of the antagonist, which can be explained as due to inhibition of the antagonistic reflex. This phenomena has been demonstrated not only for reflex stimulation of the cord but also for voluntary movements and for electrical stimulation of the cortical centers. In cerebral palsy there is loss of this inhibition with disorganization of reciprocal function.

Cerebral Cortical Function:

1. *The Motor Area* of the cortex of the cerebrum contains the upper motor neurone and is located in the precentral gyrus. Movements and not muscles are represented. In experimental work no matter how small a piece of the cortex is removed the paralysis involves a group of muscles. The finer and more delicate the movement, the greater is the area of cortex which subserves it. The finer and the more intricate movements seem to require many more nerve connections than grosser movements. For example, the area which controls the movements of the hand is about three or four times as large as the area which controls the whole of the trunk muscles.

2. *The Sensory Receptive Area* in the cortex is found in the postcentral gyrus where impulses are received from the various sensory structures of the body. There is a similar arrangement in the sensory area to that in the motor area.

The receptive areas of the cortex are greater than the motor areas. Sensory impressions are constantly coming up to the cortex of the brain and are unlimited in their variations and types. In order that these may be sorted out, some being accepted and some being rejected or inhibited, a great deal more cortex is necessary. On the other hand the muscles of the body which may react to these sensations are limited in number. Regardless of what sensory stimuli cause movement, this particular movement is controlled by the same groups of muscles. The area in the cortex controlling these movements need not be as large. This physiological fact demonstrates the rationale for the sensory approach in muscle education in cerebral palsy to lower the hyperirritability of the sensorium.

3. *Association Areas* of the cortex when stimulated with an electrical current do not produce either muscular movement or appreciation of any particular sensation. They have the function of associating sensory impressions, received by the various sensory receptive areas of the cortex, and of correlating

these into a concrete whole which we speak of as memory. Thus surrounding the auditory receptive area there is an auditory psychic area, and surrounding the visual receptive area there is visual psychic area. In these areas the auditory or visual memories are stored.

The two most important ideational or volitional areas are the prefrontal and the parieto-occipital association areas. Through these areas visual, auditory, sensory or proprioceptive sensations may be linked up with certain definite movements.

The White Matter: There are the following efferent tracts:

1. *The Corticobulbar and Corticospinal Efferent Tracts* begin in the nerve cells of the motor cortex. The axonal processes run downward and inward through the internal capsule and eventually end by synapse on the opposite side either with the nerve cells of the nuclei of the motor cranial nerves, or the cells in the anterior horn of the spinal cord. The axones of these nerve cells then carry the impulse on to the muscles. This is the most important but not the only motor pathway.

2. *The Corticorubral Efferent Tract's* major cells are placed somewhere in the frontal lobes. The axones run downward and inward through the internal capsule to the midbrain where they end in the so-called red nucleus. The latter also receives fibers from the cerebellum. The axonal fibers from here cross to the opposite side, going to the pons, medulla and spinal cord as the rubrospinal tract. It ends by synapsing with the anterior horn cells of the spinal cord.

There are therefore two distinct pathways between the cerebral cortex and the muscles, the corticospinal and the corticorubrospinal. The latter is called the secondary motor pathway to the voluntary muscles. It is the more primitive pathway found in lower animals. In man it has lost its former significance. The important point is that if there is destruction of the primary motor pathway, impulses still get through to the anterior horn cells of the spinal cord, but there is lost the inhibiting control which the primary motor pathways had, to give coordinated muscle function. Therefore, destruction of the primary pathway does not result in true paralysis but allows an automatic instinctive play of impulses from the rubrospinal tract, which results in hypertonia or spastic rigidity, as in cerebral palsy.

3. *The Corticopontine Efferent Tract* connects the cerebrum with the cerebellum.

Cerebellar Function:

1. *The Efferent Tract.* This begins in the cortex of the cerebellum and passes inward to make connections which finally join up with the rubrospinal tract. Therefore, the cerebellar cortex can influence the tone of muscles in response to the variations in the afferent stimuli which it is constantly receiving through the spinocerebellar tracts.

2. *Afferent Tracts:*
   a. The *Spinocerebellar* tracts bring up proprioceptive impulses from the muscles, tendons and joints.
   b. The *Vestibulocerebellar* tract brings impulses from the internal ear and has to do with the equilibrium of the body.
   c. The *Pontine Cerebellar* tracts connect with the cerebrum.

The Basal Ganglia. These are masses of gray matter found at the base of the brain. We shall not take the trouble to name them, but suffice it to say that these nerve cells seem to have the important function of inhibiting purposeless or convulsive reflex movements. When they are injured or destroyed there is no longer this inhibition, and so athetoid and choreiform movements are present. Convulsive reflex action, however, is governed by a reflex arc. Therefore, it can be inhibited, and the purpose of treatment in cerebral palsy must include this inhibition.

Conditioned Reflexes. These are obtained through the function of the cerebral cortex. They are not inherited, but elaborated and developed through training and education, and are subject to various forms of inhibition, internal and external. The following experiment by Pavlov demonstrates the development of a conditioned reflex.

If an indifferent stimulus (the ringing of a bell), which in itself causes no reflex, is associated repeatedly with another activating stimulus (food), which does provoke a reflex (the flow of saliva), finally the indifferent stimulus (ringing of the bell) will produce the reflex (flow of saliva) without the active stimulus at all. It may take thirty, forty or fifty trials before the conditioned reflex finally is established.

Physiological experiment has shown that it is possible for any external agency, as long as it can affect a sensory receptor through training or association, to produce these conditioned reflexes. This forms the rationale in

treatment, for not only may conditioned reflexes be produced, but if already present they can be inhibited.

Inhibition of Conditioned Reflexes:

1. *External Inhibition.* The activity of any portion of the central nervous system is brought to rest by the stimulation of some other pathway. An example is the reflex inhibition of a sneeze. The effect is immediate. An established conditioned reflex may be inhibited at any time through a sensory stimulus. *This is important in treatment.*

2. *Internal Inhibition.*
   a. *Inhibition by extinction.* If the conditioned stimulus (ringing the bell) is repeated a number of times without the unconditioned stimulus (food), the conditioned stimulus gradually loses its effect. This demonstrates the importance of long, drawn-out treatment.
   b. *Inhibition by Retardation.* If the unconditioned stimulus is given an interval after the conditioned one, seconds or minutes, there is retardation in the effect of the conditioned stimulus.

3. *Conditioned Inhibition.* When a well elaborated conditioned stimulus (ringing the bell) is combined with some indifferent agent (pinching the hind leg of the dog), the combination not being accompanied by the conditioned stimulus, there results a gradual loss of the conditioned reflex (flowing of saliva). However, if the conditioned stimulus is given alone, without this indifferent agent, the conditioned reflex will return.

Irradiation and Concentration of the Conditioned Reflex. Pavlov has concluded that excitation or inhibition occurring at any point in the brain irradiates over the organ at a certain rapidity which is more or less characteristic for the individual, and then flows back or concentrates on the original point. Therefore, the inhibitory state can be propagated along the nerve pathways. This spread of conditioned inhibition is important in our routine.

Proprioceptive Pathways. Sherrington has differentiated reflex motor effects, which result in tetanic contractions of skeletal muscle, from those which result in a more lasting tonic contraction. The proprioceptive receptors of the muscles and tendons and the labyrinth of the ear are particularly concerned in the elaboration of these reflexes. Voluntary movement is guided and controlled by these proprioceptive sensory impulses which travel through a chain of neurones to the cortex of the brain. There they bring into effect further stimulation of motor neurones through which the completion of the movement is effected.

Not only does this pathway have connections with the cerebellum and the higher centers of the cerebrum but also with the spinal coordinated reflexes themselves. There is, therefore, a sort of reflex arc system in coordinated muscle function of which one component is the proprioceptive pathway. When this is lacking, movement still can occur, but it is no longer coordinated or purposeful. In cerebral palsy there has been no differentiation of this pathway to connect it with certain movements since pure movements have been impossible right from birth.

Lower Motor Neurone. If there is a lesion of the anterior horn cells of the spinal cord, then none of the impulses from the higher centers can get through. The result is a flaccid paralysis, and no reflex action is possible.

PATHOLOGY

Up to the present, all kinds of conditions have been grouped together under the term "spastic paralysis." This would assume that spasticity is the only characteristic present. If this were true, then the lesion would be restricted to the motor area of the brain. Pathological investigation shows that the lesion is not circumscribed, but widespread. Even as far back as 1888, Weyhe showed that the hemorrhage was not only subdural or subarachnoid but also intracerebral or intraventricular. Not only may there be injury to the cerebrum but also to the spinal cord. Hemorrhage may occur into the spinal canal with or without fracture of the spine where extensive traction is applied to the neck. This may happen in breech deliveries. As a result there may be involvement of the peripheral nerves, the cervical sympathetic apparatus and the spinal cord.

Differential Pathology:

I. *Pyramidal Lesions (true spasticity).* The lesion is in the cortex or the subcortical region of the motor area of the heterolateral hemisphere. Spasticity is the most common characteristic in the majority of cases and has given rise to the terms: spastic paralysis, birth palsy, or Little's disease. The reflexes are exaggerated, and the Babinski sign is posi-

tive. There may be ankle clonus. The hypertonic muscles vary from slight irritability to spastic rigidity. The defect is not due to loss of muscle power but to too much muscle power.

II. *Extrapyramidal Lesions (athetosis).* The lesion is in the basal ganglia on one or both sides or in the frontal lobe. The reflexes may be normal. A positive Babinski may be present. There is tremor of an involuntary nature, with incoordination. Muscle tonus may be decreased.

III. *Cerebellar Lesions (ataxia).* These result in disturbances of equilibrium, coordination and tonus regulation, with dysmetria, ataxia and dysdiadochokinesis. The reflexes may be normal. Muscle tone may be decreased.

IV. *Sensory Disturbances.* Ataxia in cerebral palsy may be due to sensory as well as motor disturbance. The normal function of muscles depends in great measure on the proprioceptive sensations which are controlled by the cerebellum. Of course, muscle spasm itself may upset the normal proprioceptive impulses from both the muscles and the joints.

There is a loss of appreciation of the relative intensity of different stimuli. Fine differences of heat, cold and touch cannot be discerned. Tactile localization, that is, the ability to identify the part stimulated, is interfered with; so is tactile discrimination, that is, to discriminate between two points of stimulation. There are many receptive areas which are hypersensitive and give rise to spasm of the spastic muscles. The most common such areas are located at the distal parts of the extremities. All of these disturbances interfere with intricate movements. Sensory education is therefore important in cerebral palsy.

V. *Lower Motor Neurone Lesions.* There may be concomitant involvement of the peripheral nerves or of the spinal cord. This may occur as a separate entity or combined with the above. Flaccid paralysis may therefore be present, particularly of the neck muscles, combined with spasticity and athetosis. Severe injuries of the spinal cord are the most difficult to treat.

CLINICAL CONSIDERATIONS

The pure type of pathology is rare. Careful clinical examination will reveal that there is usually involvement of all three of the motor systems and that sensory disturbances also are present. One of these systems, however, may be predominantly involved.

Muscle Analysis. A very careful muscle analysis is important. The involvement will be found to be general, but not uniform. Some muscles may be very spastic, some less spastic, others almost normal and still others flaccid. By charting the muscles in similiar fashion to what is done in infantile paralysis, marking degrees of hypertonicity as well as hypotonicity, one can have a very comprehensive picture of the muscle balance present. This is important in the consideration of therapy. For example, bracing or splinting is of the greatest efficiency in hypotonia but may be contraindicated in hypertonia.

Incoordination of Muscle Action. As a result of lack of cerebral inhibition there is no longer controlled and coordinated reflex action but rather convulsive reflex action. An impulse cannot travel continuously and repeatedly along one nerve pathway. Instead, with an ideational command, there is sudden release of energy. This connects with many motor pathways, crisscrossing each other, and reaching many end terminations at the one time, whether agonistic, synergistic or antagonistic. Thus when the message is sent to extend a finger, there is not only the attempt to extend the finger, but the antagonist flexors act, or other groups of muscles of the hand, forearm or the entire upper extremity. In fact, the patient as a whole may be thrown into a violent paroxysm of muscular effort as a result of the simple message from the brain to extend the finger.

If a muscle is asked to perform a function of which it is not capable, it will not act at all. It will become hypotonic or flaccid and rely upon its synergist to carry out function. The result may be the very opposite to that which is desired. A cortical impulse leads to contraction of muscle groups, and not individual muscles. If the patient attempts to make a fist, where the dorsiflexors are hypertonic, there may be adduction of the arm, flexion of the forearm, dorsiflexion of the wrist or plantar flexion, with *extension* of the interphalangeal joints through the hyperaction of the synergistic interossei muscles. In the end there may be no flexion of the fingers at all.

In *spasticity,* there is hypertonia. When passive movement is attempted there is intense resistance at first. But it rapidly eases as the range of movement continues, just as in decerebrate rigidity. Certain groups of muscles are stronger than others, and so there is some pattern in the disturbance which

follows. This is important since, in spasticity, repetitive measures are useful and form an important keynote in treatment.

In the *athetoid*, on the other hand, there are involuntary purposeless movements which go on all the time, during the waking hours, regardless of whether there are ideational concepts or not. They are decreased during sleep or with relaxation, both mental and physical, and aggravated by intention or excitement. There is the constant tendency to perform *voluntary* movements in order to control the *involuntary* ones. These never coincide and so each movement differs every time the patient attempts it. Repetitive measures have no value. Only with relaxation and lessening of the athetosis can one institute proprioceptive sensory training.

In *cerebellar disturbance*, there is *ataxia*. This has to do not only with lack of cerebellar control directly but also lack of proprioceptive training. The child has no idea of what these sensations are like, and therefore cannot be excited by them.

There is gross clumsiness of the movements as a result of the disturbances in finer sensibility. The latter is a reinforcement to proprioceptive sensation. The importance of these facts should be stressed. They have an important bearing on the whole routine which is to be developed by the physical therapist.

CEREBRAL PALSY PERSONALITY

Intelligence. Up to 1900, the textbooks considered these cases as mentally deficient. From Gower's time to the present this feeling gradually has lessened. In 1923, Jones and Lovett considered that only some degree of mental impairment existed. In 1935, in Cecil's Text-Book of Medicine, Stevenson states: "The one well known disease of the pyramidal tracts with little or no mental defect is Little's disease." Of the cases which I have studied, fifty per cent were of normal intelligence, five to ten per cent were exceptionally bright, only about ten per cent or less were idiots or low morons, the rest being sub-standard or high moron individuals.

The cerebral palsy patient has a stupid appearance due to the lack of coordination of the muscles of expression; strabismus; wide open, grimacing mouth, and drooling of saliva. He has inability to express himself in speech. Due to lack of education, the vocabulary is small. The athetoid and choreiform movements still further complicate the picture, confusing one as to the intelligence present.

The Binet-Simon method of intelligence testing obviously is inadequate. The only sensible method is to see what the child can accomplish. If the child can make adequate progress per year under adequate treatment then he is not mentally deficient.

Energy Overflow. In order to carry out any movement there is called into play an enormous amount of energy, even when at rest for the athetoid patient. There is increased metabolism, increased catabolism, with the accumulation of waste products which give rise to fatigue. In spite of all this the amount of physical accomplishment is very little, since the movements are convulsive and not purposeful.

Hyperirritability of the Sensorium. In the quadriped the complexity of motion is not as great as in the human. Right after birth there are the alternating movements of the legs as a result of coordinated reflex muscular contractions which are quite automatic and instinctive. It is no time at all before they can walk. The young animal does not have the erect attitude to contend with and is not as much affected by the sensory stimuli about him as is the human. The normal human infant also demonstrates this alternating action, in the kicking and grabbing movements which are performed quite clearly, but these are incoordinated and at random; they are purposeless. The reason is that there is a continuous bombardment of the sensorium of the child, all the sensory stimuli having an effect in producing reflex movements. Until there is sufficient development of the brain, there is no possibility for the inhibition or shunting out of those sensory stimuli which are not required and the selection of those stimuli which are required for the movement.

As the normal child learns to stand and walk, he makes use of his optic pathways to reinforce purposeful movements by shunting out many different stimuli. If he does not look where he is going, however, he falls, in much the same way as the ataxic patient. As he learns to fix his field of vision, the gait becomes steadier. In the early years the child will play with this, and then play with that, going from one to the other following no definite pattern, each act still being uncertain but capable of some accomplishment. He is cutting out gradually many of the sensory stimuli about him, but they still do affect him in some measure. With training he learns to keep out all stimuli except the ones which

are directly connected with the act he is performing, and this is becoming conditioned. The head does not look on the ground, or to his feet, or here and there; he is facing directly in his line of vision. In playing with his toys instead of flying from one toy to the other at random, all at successive periods, he plays with one to the exclusion of the others. The development of coordinated function in normals entails selectivity of certain sensory stimuli.

The spastic athetoid may be likened to an infant since there is a poor sensory motor complex present with lack of selective inhibition of sensory stimuli. There is a continuous bombardment of his sensorium with stimuli all around him to which he seems more sensitive than the infant. They all have an effect in enhancing incoordination of muscle activity since they excite convulsive reflex action. Just as the normal person can develop conditioned reflexes through practice, in skilled motion, so can the spastic athetoid. The more the practice, the more the ability in the performance of the act, even though in the course of training there is exaggerated tension, especially at first.

The Ego. A constant setback is lack of a means of expression. Certain complexes develop as intelligence increases. There is first helpfulness, and then fear. Later frustration of desire, the fear may be replaced with worry, and the tendency is for the cerebral palsy to consider himself ostracized from society. The effect this has on the personality complex can be imagined. There must be disturbances in the sympathetic nervous system, in the glandular physiology. No wonder they are considered psychopathic, no wonder they may laugh or cry, or be mute entirely.

Attitude of Parents. Right from the very beginning these children are treated as different from the others. In front of the child all kinds of pessimistic statements may be made. Many of these parents are mental patients themselves. They feel that they should do all the thinking for the child. The latter is never to have a mind of his own, but the whole program is laid out by their abnormal attitude.

Personality. The cerebral palsy differs in marked degree from any other type of handicapped child. Right from the very beginning they feel themselves as separate and extraneous from the others. They have no feeling of personal worth or importance. They all develop abnormal attitudes towards society. The athetoid patient has an even different personality. Whereas the spastic can acquire, after some fashion, a repeated pattern even without treatment, the athetoid can acquire no such pattern.

PSYCHIATRIC—PSYCHOLOGICAL APPROACH

Introduction. There is a definite approach which the physical therapist must have if proper results are to be obtained from the physical measures which are employed. In any condition physical therapy treatment cannot be efficacious if the patient is under tension, all keyed up. Relaxation of a part is impossible unless the patient as a whole is relaxed. Muscle education in general must begin with a basic condition which we may term relaxed passive movement.

"Will Power." The cerebral palsy must be given a feeling of personal worth. He must feel that he has a right to all privileges that the normal child has, but that as much is expected of him in a comparative way. At the same time there should be no driving on of the patient. The frequent misuse of the term "will power" can drive them into chaos. They want to get well but have such insurmountable obstacles that they must be aided. Too much "will power" will increase rather than decrease athetosis and incoordination.

Selective Reduction of Sensory Stimuli. This contribution of Carlson's is important. During sleep sensory impressions are reduced to a minimum. The purposeless movements cease and relaxation occurs. After a good night's sleep the patient is hypersensitive and cannot handle many stimuli simultaneously. There is, as a result, a greater overflow of motor activity. However, as the day goes on he seems to adapt himself better so that there is some improvement. The most striking effect is seen as the cerebral palsy recovers from ether anesthesia. When the child first awakens and is still somewhat under the effect of ether, I have verified the findings of Carlson that there is less spasticity and athetosis. As the ether effect wears off, the child returns to his former status.

Carlson has demonstrated that when the patient is partially under the influence of alcohol, or sedatives like luminal, or bromides, there is a lessening of the purposeless movements. These measures, of course, are not of therapeutic value, but they do demonstrate the effect of reduction of sensory stimuli. Many

illustrations can be given. For example, a fifty-nine year old spastic has great difficulty in typing out a message to me. If, however, she has hit upon a certain idea or is angry, she may forget all else and work the typewriter with great efficiency. I have often observed that in applying colored glasses on the child who is receiving an ultraviolet light treatment the movements become more definite since the visual field is cut down to the immediate vicinity of the child. These facts demonstrate the advisability of cutting down the sensory stimuli which reach the cortex.

The cerebral palsy has the tendency to look anywhere and everywhere with peculiar jerking motions of the head and eyes. If he is walking, his head and trunk will move in all directions. If he attempts to shake one's hand, not only will there be jerking movements of the head but also of the arm and hand. If, however, in performing an act, the spastic athetoid focuses his vision upon some point directly in his environment, he will be able to execute movements with less ataxia. Thus, if in walking the patient focuses his vision directly ahead, without looking at his feet or at the floor, the gait will be steadier. In attempting to shake another's hand, if he will focus his vision on the other's thumb, his hand will reach the other with less ataxia. If in speech he will focus his vision on the other's lips or eyes, there will be improvement. These measures are of tremendous value in muscle education.

Volition. One should not adhere too closely to the development of secondary foci of attention. It is true that the spastic may have great difficulty, for example, in opening a drawer, if he concentrates too strongly on the particular act. However, if he hears the strain of music or if he is late for school and is in a hurry, this secondary focus of attention may reduce his sensorium and he may open the drawer more coordinately. His mind, however, must be upon the act which he is performing, otherwise he will sidetrack and not perform the act of opening the drawer at all. This function of volition is important and will explain much of the daydreaming of the spastic athetoid when he is placed amongst other individuals.

Purposeful Acquired Movements. The normal infant must learn to creep and stand before it can walk. The whole routine in paralytics is to begin with simple units and then summate them to develop complicated motion. In these cases there is coordination, and the summation is possible. In the spastic athetoid, however, the simple units are incoordinated. The principle of selective reduction of sensory stimuli holds. If there is a definite purpose in view then there is a span of attention, and the spastic does not concentrate upon individual movements although his volition still is centered upon them.

Brickner and Lyons have shown that in encephalitis specific acquired acts in which grace and automaticity were achieved prior to the onset of the illness still can be performed in spite of rigidity. They illustrate the case of a star pitcher who developed an encephalitis. He had the usual incoordination and walked with difficulty, but when a ball was thrown to him he caught it with perfect ease and threw it back with perfect ease. Once the act was completed, he returned to his former state of rigidity and immobility. A similar situation seems to hold for specific acquired acts in the spastic athetoid. The patient may have great difficulty in executing certain simple movements, for example, bending the elbow, and yet have much less difficulty in performing intricate movements, such as playing the piano or swimming. Do not stay too long with introductory phases in treatment. There should be a definite sequence going from the simple to the more complicated measures, but do not delay too long on one step before going to the other. The summation of all of these steps can be achieved more readily with a definite purpose in view. This stresses the importance of occupational therapy and academic work very early in the handling of the cerebral palsy case.

Self-Reliance. The assets which the patient does have should be improved and utilized so as to enable him to become a useful citizen. Attention of physical details alone is never the entire treatment. They must be encouraged to have the same desires and ambitions as the normal child. The spastic child should be given a little doll even though it is impossible for the child to play with it properly. It is an important means of building up complexes. A striking example is the following: A colleague from the East was making rounds with me. A farmer's wife was placing a little doll beside a severely handicapped spastic. She told the spastic child, "Now I am laying the doll beside you; you see how she is falling asleep and so must you fall asleep." My colleague thought it was ridiculous to waste all this time since the child could have no concept of what it was all about. He was wrong;

the child did relax and the child did fall asleep, and the farmer's wife was right. Too frequently one hears criticism of the use of such measures as these in order to build up concepts in the child's mind. It is true that relaxation will not be obtained directly from the use of such measures, but as aids they are of paramount importance.

The Psychological Approach. The psychological analysis is important but not the entire scope of treatment. Many spastic athetoids have overcome all obstacles and reached high stations in life without proper physical treatment, at least apparently. A fifty-nine year old spastic, who teaches in my clinic, obtained her Bachelor of Arts degree in spite of such severe involvement that she is unable to talk or to walk at all. She uses a typewriter to communicate with others. She cannot use her fingers at all in this but has learned to grasp a rubber-tipped wand, after a fashion, and with this strikes the keys. This is really a form of muscle education in itself. Picture how much more advanced this woman would be if she had received proper physical treatment. She would not have had to wait until fifty to obtain her Bachelor of Arts degree.

In the very young, psychological analysis is impossible and physical treatment must be the first step. In older cases with, for example, severe flexion-adduction contractures of the hips, flexion deformities of the knees, equinus of the feet, an entirely different approach may be necessary for it to be indeed psychological. He may have received all kinds of treatment from doctors, chiropractors and osteopaths. At first he was enthused with their encouragement, but with their failures he has become all the more reconciled to the belief that he is incurable. This patient is not amenable to psychotherapy at all, as a preliminary measure. The first step is to prove to this patient what can be done. The legs should be straightened out by surgery; this demonstration is the most potent factor in relieving the tension and deadlock which is present. Then one can go on with psychotherapy, conservative measures, and such.

Danger of Deadlock. Too much has been expected from these spastic athetoids. The differentiation of the nervous system in them is slower than in the normal. The capabilities of the patient depend upon anatomical and physiological details. If muscle education is pushed beyond their capability, there is the development of physical deadlock which can produce mental deadlock. The psychiatrist receiving such patients, who have been inadequately or over-treated, has found that mental rest, as well as physical, improves not only their mental but also their physical condition. This is not the fault of the physical treatment, however, but of the method of its administration.

It is true that mental deadlock prohibits coordinated muscle function in cerebral palsy. At the same time every physical barrier results in mental deadlock. Psychiatrists have shown that in left-handed children, the tying of the left hand behind the patient's back in order to make him use the right hand in many cases results in disturbances of speech and mental behavior patterns. In the same way physical barriers in the spastic athetoid are instrumental in producing mental behavior patterns. Speech disturbances are not so often due to involvement of the speech centers in the brain, but they follow because of the same pathological description as laid down in our previous discussion and because of physical barriers. It is amazing how the removal of these physical barriers improves the mental status, starts speech off, and lessens the drooling of saliva and the grimacing of the mouth.

GENERAL PRINCIPLES

Timing Treatment. Treatment is started as soon as the diagnosis is made. All the harmful phenomena are progressive in character. Although most of the deformities are plastic in the early stages, the stronger muscles soon produce contracture and deformity. With this there is all the more impairment of proprioceptive sensations. The result is a sort of vicious cycle in which physical retardation enhances mental impairment. At the same time mental retardation encourages physical impairment or incoordination. There is an inherent tendency in the normal for the child to walk by the age of two and to talk well by the age of five. Every attempt must be made to duplicate this in these spastic cases. As the child becomes older it requires much more coordination for balance. Every fall, every hurt, has a greater chance of leaving more imprints in the mental life. Then again with continued chaos, certain movements are encouraged which may be vicious in character. The spastic may learn incorrect strokes just as the poor swimmer. It becomes increasingly

difficult to correct these strokes the older the patient becomes. The work can be more efficiently carried out when mental behavior patterns are absent. There is then full opportunity for building up a visual and auditory vocabulary which can be correlated with motor acts, through a process of conditioning which we call education.

Segregation. Probably none of us realize the important transformation which takes place in the human individual during the preschool years. Many have stressed the importance of segregating spastics of school age from other individuals so as to prevent the formation of mental behavior patterns. They illustrate the case where the spastic is ridiculed by other normal children, or where the spastic finds himself at sea in competing with normals. They do not realize that these mental behavior patterns are forming not in the school age (they have already formed by then), but in the preschool age.

I agree that there should be special schools, homes or clinics for cases of cerebral palsy, but in the preschool age, rather than the school age. By congregating spastic children they get along much better from a sociological as well as an educational viewpoint. Their educational problems are entirely different from all other cases. It must follow an approach which relates concepts with motion. These concepts, built up through constant teaching, lay the basis for the development of conditioned reflexes which later can produce coordinated movement. All the rhymes, legends, pictures and demonstrations thus can be linked up with active motion.

When the child reaches the school age he should be subjected gradually to the environment of normals so that he can be developed as a member of the community. I have found that no matter how well the spastic is developed in the cerebral palsy class if he is suddenly projected into the external world, he is lost. If, however, there is gradual introduction to the external world, and the same conditioning process relates with this, he soon develops an immunity against environmental stimuli so that they are less apt to produce convulsive reflex action.

The Use of Ultraviolet Light and Inorganic Salts. The erroneous statement that ultraviolet light increases rigidity has not been found true. On the contrary it has a beneficial effect, and this may be due to its relationship with the calcium balance of the body. Amongst other functions, calcium, along with other ions, maintains a balance in the blood and tissues. Calcium ions control the heart beat, the contractility of plain and striped muscle, and the transference of impulses at the neuromuscular junctions and through synapses. Calcium lessens the irritability of tissues. Sodium and potassium ions have an antagonistic action against calcium ions. Heavy doses of calcium are therefore given these patients, and to enhance its action, cod liver oil or vitamin D is given.

Sunlight is preferred to any artificial source, not only because it is cheap and always available but also because of its infrared rays. These heat rays have a sedative effect and enhance relaxation. It keeps the child outdoors. In winter and on cloudy days ultraviolet light can be used, and the author prefers the carbon arc lamp. At first ultraviolet rays may increase irritability, but after several treatments this irritability is no longer present.

PHYSICAL THERAPY MEASURES

Coordinated Muscle Action. Aside from simple reflexes, each muscle contraction calls into play a large number of nerve connections. Conditioned reflexes are stored up in the normal brain so that when a certain movement is contemplated, a message is sent from the ideational center to the motor cortex. From the motor nerve cell it travels down the medulla and the cord to the anterior horn cells. From here it passes along the nerves to end in the neuromuscular junction. There is a connecting system with the cerebellum through which movement is controlled so as to result in coordination. Voluntary movement is a complicated series of events, each link in the chain being absolutely essential. If the ideational center, or the moral center, is at fault, the individual will make no attempt at all; he will malinger. If the potential of this center be lowered, as a result of fatigue, there is the development of "neurasthenia." If the cerebral palsy has a lowering of the moral center, he will not work. If he tries too hard or is spurred on too much, he becomes physically and mentally fatigued, "all tied up in knots." If there is a hyperirritability of the sensorium, the ordinary environmental stimuli will result in convulsive reflex action unless this is inhibited by further conditioned reflexes.

The break in the continuity of the sequence of events may occur lower down than the

volitional center. In this instance the patient is no longer able to get his message through all the relays to the muscles. In splint atrophy, for example, after prolonged immobilization, the patient may have forgotten how to direct this impulse through. Muscle re-education can be instituted, for the ideational center in the past has developed certain routine pathways for the nerve impulse to follow. There has been no cerebellar disturbance, with concomitant destruction of proprioceptive equilibrium. In cerebral palsy, however, the problem is much more difficult. There has never been the association of certain movements with ideational concepts. There has never been the development of proprioceptive sensibility. The whole process has to be developed. It should be termed muscle education rather than muscle re-education. Surgical intervention or curare therapy never can obviate the necessity for this routine. Granted that we do lower the athetosis by section of the extrapyramidal tracts, as advocated by Putnam or resection of the premotor area as advocated by Klemme; there remains none the less the necessity for the development of coordinated muscle function. Supposing that curare therapy does decrease spasticity and lessen athetoid movements, there is still the whole routine of muscle education which is to be followed. It is not that these surgical measures are of no value but that they have a limit to their possibilities, and that these operations can be made successful only through a postoperative routine of muscle education. In observing many of these postoperative cases I have been struck with the fact that there is lessening of the athetosis and decrease in the spasticity, but when purposeful movements are attempted there remains the convulsive reflex action rather than coordinated reflex action.

Objective of Physical Therapy. We must break through the physical barriers present by inhibition of increased muscle spasm or by lessening athetosis. Certain pathways must be established to develop conditioned reflexes so that coordinated movements can be correlated with ideational commands. The hyperirritability of the sensorium must be lessened. Convulsive reflex action must be inhibited.

Although the psychological approach to the severe athetoid is somewhat different to that of the severe spastic, there is a fundamental basis in the physical treatment of both. The first step is to develop a proprioceptive sensory education so as to pave the way for motor coordination. Before this can be accomplished, concepts (related to movements) must be developed, and this is the function of the educational program for the child in the home, in the clinic or in the special class room. Every phase of the work, whether it be that of the educationist, the parent, the surgeon or the physical therapist, must be interrelated. It is not simply the application of heat and massage, or the giving of muscular exercises which makes up a well balanced routine, but the combination of these preceded by an adequate educational program. If the child has seen "the raising of the arm" in a picture and has a visual impression of this, the visual impression strengthened by the auditory statement "the raising of the arm" all the more easily can be linked up with proprioceptive sensation.

We already have seen how important this proprioceptive sensory education is in reciprocal action. It, of course, depends upon joint and muscle movements. Before coordinated flexion of the wrist can be performed, there must be a linking up of the proprioceptive sensations connected with such a movement, with the higher centers in the brain. As a result of these proprioceptive sensations, inhibitory influences are brought to bear upon antagonistic muscles. If pure flexion cannot be obtained without interference from surrounding muscle action, there can be no proprioceptive sensory education as far as pure flexion movement is concerned. It is essential, therefore, that all movements be eliminated except those which are desired for the moment. It matters little whether these movements are performed actively or passively since it is proprioceptive sensation which is required. Active movements upset the whole unstable activity; therefore, passive motion is the first prerequisite in the development of proprioceptive sensibility.

We must distinguish between forced passive movements and relaxed passive movements. Passive movement in cerebral palsy differs entirely from one in infantile paralysis. A truly passive or relaxed movement is one which can be performed by the masseur without either assistance or resistance from the patient. When the part is not paralyzed there must be cooperation from the patient and this depends upon active relaxation on his part. Mennell calls these relaxed movements. The first essential is the institution of relaxation. There is no specific form of therapy but many measures may be used in order to enhance relaxation.

Electrotherapy is of no value at all for reasons that are quite obvious.

Application of Heat. Any infra-red baker or lighting unit is efficient. There is no particular virtue to diathermy since its only value lies in heat production. The other units can be used much more cheaply and can be procured anywhere. The heat should not be intense, nor should it be unduly prolonged. Twenty minutes is a sufficient dose. If this has a depressant or irritating effect the intensity and duration should be lessened. If the pulse becomes rapid the application should be discontinued. Heat is used merely as a preliminary for the use of massage. It does have in itself a tendency to encourage relaxation. Hydrotherapy is valuable in certain cases. Cold should be avoided at all times, and particularly is this true of the cold douche.

Massage. This is a controversial subject since the principles have been harmed by inadequate control. The object of massage in cerebral palsy is to act as a sort of sedative, to reduce muscle tone and to relieve accumulation of waste products. The tissues being massaged are hyperirritable. They can be considered as being semifluid in consistency. By the laws of hydrostatics, any pressure, no matter how slight, exerted on this medium, will be transmitted in all directions. There is no requirement for the use of heavy movements. A light effleurage is given for its reflex, sedative effect, as well as some mechanical effect, and therefore decreases muscle spasm. The criticism of so many to massage is correct insofar as it is applied to the types so commonly used. Massage used properly will be very useful in enhancing relaxation and inhibiting increased muscle tone. There are certain receptive areas at the distal portions of the extremities where even light effleurage can result in increased motor spasm. Such areas should be avoided or approached with caution. All work should be rhythmic, but then this is true of massage in general.

Relaxation. This is difficult to define. There is a minimum of muscle group preponderance, and both agonists and antagonists are ready to let out the slack on short notice. There is no cessation of muscle activity just as there is no cessation of chemical activity when equilibrium occurs in a reversible chemical reaction. The limb is pliable for passive movements. In the spastic there is less tendency for the occurrence of the stretch reflex, and in the athetoid there is less involuntary motion when the part is relaxed.

Relaxation is very difficult to obtain, for not only must there be relaxation of the part but also of the patient as a whole—both physically and mentally. In cerebral palsy this is very difficult since the whole make-up of the patient is one of emotional disturbance. It must be stressed that relaxation of the spastic does not mean immobility. This can but accentuate his difficulties. Only when he is allowed range of movement can the spastic relax. Do not tell him to hold his head still, but control the movements of the head indirectly through the principle of selective inhibition of sensory stimuli.

In the very young it is difficult to make the child understand just what is desired. He may believe that he is being played with and so his movements become even more active. Do not despair, for after months of constant effort, the goal may be reached suddenly. It is important to begin in the young because at this time the deformities are plastic and moldable.

In the older child and in the adult one cannot expect relaxation simply by telling them to relax. Knowledge of the psychological approach is essential in the handling of the patient.

Inhibition of Muscle Spasm. Heat and massage alone are insufficient to develop relaxation in cerebral palsy, even with cooperation. Because of the hyperirritability of the sensorium, one must eliminate as much as possible all sensory stimuli except those desired. Noises will produce convulsive reflex actions. Therefore, the use of quiet and darkened rooms is useful. Gradually, as the patient develops, light and noise may be introduced in increasing doses. There must be focusing of attention, not upon the act performed, but rather upon some point directly in the line of vision.

The use of gentle, sustained and very gradual stretching of the stronger muscles is an important aid. Particularly is this true in spasticity. The spastic muscle follows somewhat the same rule as in decerebrate rigidity. At first as a passive movement is started the stretch reflex will be invoked and rigidity will be at its greatest. As the sustained pressure continues and the passive movement continues, the degree of rigidity decreases and a plastic elongation of the muscle occurs. Since this rigidity decreases as the range of movement increases, it has become the routine to begin with the larger muscles before going on to the smaller ones. This is called the proximodistal routine. Another reason for this routine is that the more intricate the movement, the greater the area of the cortex involved. One

leaves the more intricate movements for later when the hyperirritability of the sensorium has been lessened. This principle does not hold absolutely true for reasons already considered in the psychological approach. In performing these movements gentle and sustained motion is emphasized. Any sudden jerking will be deleterious and will increase rather than decrease the spasticity.

Sustained pressure against the weaker muscles, or those muscles whose action is desired, is very useful, particularly in athetosis. Through the sensory effect so produced an inhibitory influence may be brought to bear upon conditioned convulsive reflexes and upon antagonistic muscles. At the same time there is a possibility of linking up these sensory impulses with proprioceptive sensations produced as the weaker muscle contracts, thus emphasizing the sensory stimuli of the region and correlating this with the ideational concept in the brain. These are powerful measures not only to inhibit increased muscle spasm but to lessen the athetoid movements. One works with relaxed movements proximodistally; that is, the shoulder muscles will be treated, then when relaxation is produced, the elbow muscles. As one approaches the more distal receptive areas much more care will be required, since these are hypersensitive and can be built up only gradually.

Through these measures there is encouraged active relaxation with inhibition of increased muscle spasm. This relaxation becomes more easily produced as the work goes on and may remain present for longer and longer periods of time after the cessation of treatment. This inhibitory afterperiod gradually extends, and finally it becomes permanent; that is, conditioned. When this is so, the extremity becomes pliable; muscles may be stretched without producing the stretch reflexes, and relaxed movements are then instituted. With the first sign of return of increased muscle spasm, the process is repeated. The movements should be slow and the patient's attention concentrated on them. This can be enhanced by demonstrating the movement to the patient first. As the movement is instituted the masseur issues the command "abduct the shoulder," or "adduct the shoulder." Through this attention training, the proprioceptive sensations are registered in the ideational center and reinforced through other sensory impulses. In this way sensory education is brought about.

Just as in Pavlov's experiments there is a tendency for the inhibition of increased muscle spasm to spread so that it can indirectly influence contiguous muscle. This principle is very important, for example, in speech training in cerebral palsy. It is very difficult to demonstrate the movements of the finer muscles connected with speech, but fortunately when one institutes the conditioned inhibition of increased muscle spasm of the neck, head and face muscles, there is spread of this inhibition to the muscles of speech. In treatment it is found that as this conditioned inhibition spreads, the patient who was unable to make any intelligent sounds at all can speak words and sentences after a fashion without any speech training at all. This does not mean that the scientific speech correction expert is not necessary. On the contrary he has a most important part to play. It is just as sensible for the cerebral palsy case to get up and walk or perform gymnastics as to be taught adequate speech training without these preliminary measures. The physical therapist must prepare the cerebral palsy case for the speech correction expert.

The routine is very slow. I have not found that it is so essential to adhere too closely to the proximodistal routine. These cases can acquire more complicated acts as long as they have a purpose in view. The patient must keep in mind the end which is to be achieved by motion. He is thus taught to associate certain movements with certain commands. Proprioceptive sensations are developed—sensations which never before existed with movements. It goes without saying that the usual rules for carrying out relaxed movements hold in these cases as in others. Both the patient and masseur should be comfortable and relaxed. The latter should support the part treated so that not only is there a sense of ease, security and repose, but there is no necessity for the patient to use his muscles. Each movement should be analyzed so as to imitate nature in its conservation of energy; for example, dorsiflexion of the wrist is accompanied by flexion of the fingers; volar flexion with extension of the fingers.

Relaxed movements keep the joints supple. There is no opportunity for contracture of the muscles and fascial planes; therefore, it is a safeguard against the development of contracture and shortening. There is the education of the joint sense, the muscle sense and the tendon sense, thus developing the main link in reflex coordinated movement.

The physical therapist must realize the objectives. If passive movements are attempted

without relaxation, the stretch reflexes are invoked and there is increased irritability. These passive movements do not form the cure of cerebral palsy, but they pave the way for proper muscle education.

Muscle Education

Introduction. Muscle coordination depends upon muscle action; however, one does not simply go on to movements without a definite routine in view. Speed and resistance are important factors which endanger coordination. Action current studies have shown that in the simplest type of motion, called the pendulum-type, one has a form of active movement which is relaxed in character. The forward and backward swing of the arm is a pendulum-type of motion. If the action currents are led off from the anterior and posterior portions of the deltoid muscle, it is noted that the motor impulse is present only at the beginning of the swing. The energy moves the limb forward against gravity. The velocity becomes less and less until it finally reaches zero. The opposite movement then occurs and the posterior portion of the deltoid muscle, the antagonist, acts. Gravity may be sufficient to bring the arm back, but if the deltoid is used the oscillations again occur at the beginning of the backward swing. In this movement, at the beginning of the forward swing, the anterior deltoid contracts while the posterior deltoid relaxes. With the backward swing the opposite occurs. The electrical reactions show that the movement is tetanic in character. As a result there is not one rise in potential but a series of oscillations. The oscillations, however, occur at the beginning of the movement.

If the velocity is increased, the impulses of contraction increase in amplitude and frequency, the peaks becoming higher and more crowded but still occurring in the beginning of the swinging phase. As the velocity still increases, there is a difference in the timing action of the antagonists. They no longer occur at the end of the agonistic phase but may be recorded during this phase. If a weight is added to the limb a similar situation occurs. Speed and resistance complicate the picture so that finally agonists and antagonists both act together. At first the antagonistic action has a certain regularity, showing elevations at certain points. As the rigidity of the movement increases, however, agonists and antagonists seem to act synchronously. They are no longer periodically active or inactive but merely periodically weaker or stronger. There seems to be a loss of the reciprocal action as seen in the pendulum-like movement. This does not mean that the law of reciprocal innervation does not hold. Every act is a complicated series of movements, each of which demonstrates the law of reciprocal innervation, but the summation may not demonstrate it. In other words flexion of the elbow is not a simple movement. There are tetanic contractions of the agonists and antagonists, depending, of course, on the speed and resistance accompanying the movement. Each step which leads to the final flexion does demonstrate the law of reciprocal innervation.

With pendulum-like motion one has the simplest type of active movement. There is less crisscrossing of impulses, of agonists and antagonists. This forms the first step in the muscle education plan in order to develop conditioned reflexes and to educate the proprioceptive sense. It is not so much then a question of performing this or that exercise. Muscular gymnastics represent a highly coordinated form of muscle function. Before this stage is reached there are a whole series of intermediate steps leading from relaxation to gymnastics. The moment that speed, resistance or directed motion enters the picture one passes away from the ideal situation for relaxed active movement.

There is selectivity of muscle action depending upon certain situations. The exact result of muscle contractility depends upon the resistance which it has to overcome. It must be realized that gravity is a definite force which can complicate muscle action. In the early stage of active motion one must work with gravity. As the muscle develops its action, then one can work against gravity, and then against graded increase of resistance. Each muscle function must occur at the proper time and at the proper place. The integration of these muscular movements give rise to harmonious motion only if the above is true. Muscular action which is not harmonious had better be removed.

Principles of Muscle Training

Principle I. *Development of Volitional Center.*

Principle II. *Inhibition of Exaggerated Muscle Tone.*

Principle III. *Development of Proprioceptive Sensory Concepts.*

Principle IV. *Reciprocal Action.* A weakened muscle cannot and will not contract prop-

erly unless and until its antagonist relaxes in conformity. The first step should, therefore, be the relaxation of the antagonist since muscle contraction only too readily occurs in cerebral palsy. Mennell relaxes the antagonist by arranging the posture of the patient so that gravity will oppose the action of the antagonist and assist that of the muscle which it is desired to train. The antagonist is allowed to contract, then the patient attempts to contract the agonist. If no movement takes place, then it is evident that the antagonist has not relaxed, for if it had done so the effect of gravity alone would have produced the movement even if no action of the agonist took place. Until gravity is successful in producing this movement, then all attempts at training the agonists are of little avail.

PRINCIPLE V. *Movement Demonstration.* The patient's muscle should at least know how to perform the movement desired. For this not only must the patient know fully what is desired so that the ideational center will function, but there must be relaxation of the antagonist. If there is a sound side and an involved side, carry out passive and active movements on the sound side. When well mastered here, have both the involved and the uninvolved sides act together before carrying on with the involved side alone.

PRINCIPLE VI. *Line of Vision.* Movement demonstration means that the line of vision should be directed on the masseur, not on the part which is to be activated. In the consideration of selective inhibition of sensory stimuli it was noted how important it is that the vision be focused in the proper manner. If the patient is too intent upon the particular movement of his extremity there is increased spasticity and rigidity.

PRINCIPLE VII. *Capability of Muscle Action.* Whatever task is set for a muscle to perform there must be the ability to perform it. Weakened muscles have an idiosyncrasy in that the muscle will not attempt to do that which it knows it is not capable of doing. On the contrary it will tend not to act at all and allow the synergists to produce the action demanded by the volitional center. The result may be just the opposite to what is desired. Some such muscles may appear flaccid.

PRINCIPLE VIII. *Pendulum Motion.* Mennell meets the problem by a dual arrangement. First, he arranges the posture in such a way that the action which is desired can be carried out without undue effort or strain even if it is necessary to invoke the assistance of gravity in order to eliminate the necessity of synergistic action. Second, it is ensured that only two muscle groups act within the limb; namely, the muscle which is to contract and its antagonist. In other words combat the apparently uncontrollable instinct on the part of the patient's muscles to make too great an effort to produce the movement desired. This weaker muscle which one is trying to develop is terribly handicapped in its earliest attempts at contraction by the over-zealous efforts of other muscles. Naturally, if this state continues for a prolonged period of time, a vicious cycle is established. In order to build up effort one must begin with the simplest muscle contraction situation as in pendulum movements.

PRINCIPLE IX. *Spacing in Muscle Education.* There is the ever present danger of the physical therapist or the parents trying to rush things, attempting to do more at one time, in order to hasten the desired result; instead they retard it. The constant high tension and the high rate of muscle metabolism mean a greater accumulation of waste products with the consequent development of fatigue. With fatigue there is not only loss of further progress until there has been complete recovery, but there is the inevitable imprint on an already frustrated mental complex.

For this reason many psychiatrists do not believe in muscle education. They have taken over a patient who is "all tied up in knots," after an intensive course of muscle education, and after a long physical rest, there is definite improvement not only of the mental status but also of the physical. In reality this is not muscle education; in fact, it is muscle abuse. To attempt to drive on spastic muscles which are nearly in fatigue is similar to the giving of a strong stimulant to a very weak heart or the flogging of a tired horse. One of the early signs of beginning muscle fatigue is the sense of fatigue of which the patient will complain, and the increased tremor.

The rule should be "a little at a time, many times," rather than "all at one time." At first give short treatments of ten to twenty minutes duration, then gradually increase the time spent on muscle education. If, after several treatments no progress is made, do not persist but give the patient a period of rest from the exercises, continuing the heat, massage and relaxation. This will further relax the muscles and remove the waste products which have formed. In this way the work can be continued

with very little danger of fatigue or the development of mental deadlocks. There should be a definite routine so that the same period is taken each day for the same type of treatment. It is well to work six days a week and give the patient one complete day of freedom.

PRINCIPLE X. *Gradation of Activity.* When active, directed movements are started, begin with the simplest. After one effort is well organized and controlled, proceed with the next which should be just a little more complicated than the previous one. The movements at first are assisted by gravity, and then gradually this assistance is withdrawn until it is resisted by this force. With the use of gravity as a resisting force, aid may be necessary to accomplish the movement. Jones and Lovett advise that the movement be aided gently with the hand even if it can be performed, until the maximum of voluntary movement has been reached; then carry the movement passively a little beyond by means of a gentle stretch. This is repeated over and over again. With each voluntary extension, the power and range increase slightly. Nonweight-bearing exercises always are preferable to weight-bearing ones in the beginning. Gradually the assistance to the movement is withdrawn and resistance introduced.

PRINCIPLE XI. *Cultivation of Rhythm.* Spastics, although unable to perform directed movements even of simple nature, may yet be able to perform rhythmic movements, especially when these are carried out rapidly, but these may not have the same regularity or rhythm as the uninvolved side. There has developed the tendency on the part of some trainers to cultivate rapid rhythmic movements. I believe that this is harmful. I have seen many spastics who have been taught peculiar, rapid, shuffling gaits, who do well as long as there is no obstacle, but if there is, they go to pieces. This does not mean that the cultivation of rhythm need not be made part and parcel of the routine in training, but it does mean that at no time should training cease when this rhythmic gait is accomplished.

Jones and Lovett stress drill in rhythm and state that it can be accomplished in three ways: (1) by performing movements synchronously with the opposite side; (2) by performing movements to the beat of a metronome; and (3) by marching to music, or by getting accustomed to the sound of the footsteps when walking on a hardwood floor and learning to make the sounds alike on both sides.

PRINCIPLE XII. *Importance of Voluntary Motion.* The whole aim of muscle education is the development of function This is the particular end in view, and all measures used are but adjuncts to attain this end. It is effort—strong, persevering, repeated and voluntary—which is essential. The development of an athlete does not depend upon the amount of heat and massage which he can receive; it depends rather upon his active training.

It is the active use of muscle which brings about development and coordination. One expects too much from physical therapy if one believes that the muscle can be trained with the measures of heat, massage and passive movements. Not only will they not suffice, but harm will be done since the patient may be lulled into the belief that nothing else is required. Fundamentally, it is the patient himself who must contribute most to his own progress.

PRINCIPLE XIII. *Submaximal Active Motion.* The weaker muscles cannot carry out maximal movements. For example, if there is a tendency for the patient to walk with the knees flexed due to the greater strength of the hamstrings, to attempt maximal action of the quadriceps group makes matters worse.

MacKenzie believed that each muscle has one action and that it cannot perform this action unless the antagonist is relaxed, but Steindler, Scherb and others have proven the multiple functions of a muscle. I have verified this myself. Although the name which is given to a certain muscle often will indicate an action of which it is capable, it is by no means its only action. Most of the muscles of the foot cross over several points; each joint over which it crosses may be affected by its contraction. The muscle usually crosses the joint in relation to more than one plane. There is action about a frontal, a sagittal and a transverse axis. As the angle of the muscle direction varies, its action varies. A study of these muscles is by no means a simple matter. A muscle or a group of muscles, acting unopposed, will produce one set of movements; while, if opposed by the action of another muscle or group of muscles, a different set of motions will be set in play. Although theoretically it would be desirable to develop one function per muscle, practically this cannot be done.

In the motor cortex of the brain only muscle group action is considered, not individual muscles. If the motor cortex orders extension of the knee and this cannot be performed maximally and yet is attempted, the result is

the following: The quadriceps group, realizing they cannot perform the movement maximally, may not try to function at all. Since this muscle is not represented on the cortex, but only the movement of extension, the continued attempt at maximal contraction may result in contraction of other muscle groups. The result then would be that the more the patient attempts to extend the knee, the more it will flex. Extreme effort put forth in order to make these weaker muscles act results in contraction of the stronger groups, until nearly the whole body vibrates with the contraction of all the muscles. If the quadriceps have sufficient strength to produce movement to 140 degrees, but not to 180 degrees, advise movement only to 140 degrees; and this should be spaced properly so that the required rest follows. Gradually the extent of the movement can be increased until 180 degrees is attained, using assistance as advocated by Jones, if necessary, to reach this stage.

PRINCIPLE XIV. *Prevention of Shortening.* There is a general rule in orthopedic work that a muscle enfeebled by disuse or disease should not be allowed to stretch, hence all sorts of splints are devised to prevent stretching. A muscle consists of contractile tissue and fibrous elastic tissue, and with the continuous elongation and shortening of the muscle, one prepares a smoothly working unit. If the joint is kept from going to full extension or full flexion, then there is adaptive shortening not only of the muscles and their tendons but also of the ligaments and capsule of the joint. The elastic property of muscle, tendon and ligament throughout the limb must be maintained. This is effected by relaxed movement and graduated active motion which may be assisted.

PRINCIPLE XV. *Retracement.* It is a good plan to go over the scales, so to speak, from time to time. Where there is development of deadlock, no attempt should be made to continue. It is best to give the patient a week or even two weeks' rest, and then start at the beginning. Progress is then rapid, and the patient soon reaches not only the stage where deadlock developed, but a stage where he can progress more rapidly than before. It is to be a rule that the progress made after each treatment should be greater than that of the preceding one. If this is not attained, then either too much has been done and the patient is fatigued, or incorrect treatment has been administered. When this occurs no attempt should be made to continue, but one should return to measures requiring less effort.

PRINCIPLE XVI. *Active Motion of Agonists and Antagonists.* Too much attention has been centered upon developing the weaker muscles. This is true in infantile paralysis where instructions are given to prevent the contraction of the antagonist for fear that it should overdevelop its strength. This is entirely theoretical. Use the stronger as well as the weaker muscles, but the stronger muscles much less than the weaker. Develop the weaker by active movements. In this way the muscle is taught voluntarily to "pay out the slack" as its antagonist contracts, following the rule of reciprocal innervation. This is the only means whereby one can develop coordination of muscle function and this is the key to success.

SURGICAL MEASURES

Surgical procedures are decidedly useful as adjuncts in treatment. The controversial aspects are due entirely to lack of appreciation that it is but one item in treatment. The use of splints and braces is well worth while when properly designed and fitted. Rapid stretching or intermittent stretching is harmful and aggravates muscle tone. Gradual and continual stretching, however, does elongate soft tissue structures. It is true that by relaxed, passive movements over a prolonged period of time mild deformities can be corrected. In moderately severe deformities it requires so much time, effort and expense that it is much better to advise bracing or splinting. The time then can be better utilized for muscle education. Where bracing and splinting are inadequate, I do not hesitate to advise surgery. For proper coordinated function all deformities must be corrected. This may require surgery but it does not obviate the necessity at all for the use of the conservative measures already considered.

Certain operations can be performed immediately. This particularly has reference to relief of contracture or deformity. I have operated upon patients as early as the second year. For example, it is impossible to teach equilibrium and gait when there is a severe equinus deformity. Correction of the equinus makes the subsequent course all the smoother when it comes to the more advanced forms of muscle education and balance work.

Those operations which require to be preceded and followed by muscle education must not be performed until the patient is ready

for it. If performed too soon so much time will elapse that when the patient finally is ready for muscle education, the whole set-up may be so rusty as to jeopardize the result.

In the correction of deformity, whether it be by surgery or by splinting, the older method of maximum correction at one operation must be condemned. Calot even performed redressment under anesthesia and then applied a cast to hold what he had gained. This stretching may be beyond the tolerance of the patient, and the result is increased tonic spasm, tension and pain. Gradual correction is the secret of success. For this reason I am in the habit of using various turnbuckle cast appliances so that the correction obtained is of a gradual and sustained nature. Frequently surgery will have to be combined with turnbuckle methods. For example, flexion contracture of the knee may be treated by tendon lengthening or capsulotomy. Maximum correction, however, is not obtained at once but obtained gradually through the use of a turnbuckle appliance. After the removal of an appliance when the patient has been held in a position of correction there frequently ensues a period of increased irritability. The secret of handling this type of difficulty is in the gradual removal of the appliance and the institution of those measures which do not irritate. If the massage still irritates, then postpone it. If the heat irritates, then postpone it. After several days the patient will be relieved of his irritability and then relaxed movements may be instituted.

There are many principles which guide the surgical procedures in the treatment of cerebral palsy. Certain measures have to do with the correction of deformity. In fact this may be the first step in order to enable relaxed movements to take place.

The actual surgical procedures do not concern us at this time, but suffice it to say that it is not a question of simply splicing a tendon but rather of knowing just what to do and when to do it. Tenotomy, tendectomy and tendon lengthening are the most common procedures used. Nerve resection to cause a paralysis of hypertonic muscle is a very valuable procedure. The correction of deformity is not the cure of the condition; it is merely a means of enabling the physical therapist to carry on those measures which we have already considered. Tendon transplantation, as a general rule, is not instituted until the patient is well versed in the muscle education plan, and the principles which guide it depend upon the muscle analysis. Tendon transplantation requires a very careful regime of postoperative muscle education.

Sympathetic ramisectomy is entirely fallacious, as is cerebral decompression in late cases. Lumbar puncture is of value in a certain small minority where the spinal fluid pressure is increased in the early years. Arthrodesing operations are not of great value except in the foot. There are two outstanding neurosurgical operations. One, intended for spasticity, is section of the posterior nerve roots as advised by Foerster. This is a very dangerous operation with a high mortality. The good results are in the main due to an intensive postoperative muscle education plan. The other operation, intended primarily for athetosis, is section of the extrapyramidal tracts in the spinal cord as advised by Putnam. This is also a very serious operation with a high mortality. It seems that the good results that can be expected from it again must depend upon the postoperative muscle education plan.

Recently Burman has presented his remarkable work by the use of minimal doses of curare. The drug provides release of spasm and muscle rigidity to varying degrees. Although it does pick out the hyperinnervated muscles, it must have a general weakening effect on the patient as a whole. It is a very excellent adjunct but can never be the treatment of cerebral palsy in itself. There is still the necessity for developing coordinated muscle function along the lines advocated.

DEVELOPMENT OF BALANCE AND GAIT

All deformities and contractures must be corrected while they are still plastic. The earlier one attempts to get the spastic child on his feet, the better the result. This timing tendency already has been considered. The preschool period is a most vulnerable one. Much work can be done in this age group in correlating visual and auditory impressions with motor acts.

Balance in cerebral palsy is poor, not only because of the spasticity or the athetosis, but also because of poor proprioceptive sensory development. Before the patient can walk he must be able to stand. Right from the very beginning all measures within physiological limits must be taken to encourage standing. If braces are required, they can be used. If deformities are present which prevent balance, they should be removed. The child has enough trouble in standing because of proprioceptive

sensory impairment without aggravating the condition by deformities.

There are certain phases in the development of locomotion: In the *first phase* all the deformities have been corrected, there is relaxation to some degree of antagonistic muscles, and there has been inhibition of motor spasm. The limbs are pliable. The child can be placed upon his feet, although braces may be necessary so that the extremities do not fold up. He can stay on his feet as long as one or two assistants constantly support him, otherwise he will fall. He is still without a sense of equilibrium. With constant effort the *second phase* is achieved, and the child can stand on his feet without the aid of attendants. He may require the use of splints, braces, crutches, sticks or a railing. The important point is that he has acquired the sense of equilibrium. Once the child tips over beyond the line of gravity, he falls and cannot recover balance. He cannot take steps, and it is at this point that no false movements should be taught. It is easy to learn to swim with incorrect strokes, but the individual will never develop properly. Once these incorrect movements are learned it is difficult to eradicate them. It means learning all over again, and more so since he has to unlearn many defective motions. This does not mean that the cerebral palsy child walks off immediately with correct steps. Pendulum movements can be instituted along the lines considered in muscle education. The leg may be swung forward at the hip even if a long leg brace is applied. This pendulum movement may be assisted by the attendant. The leg is swung forward and the patient helped forward to balance over this leg. The attendant lets the patient go so that he balances himself. The process is then repeated with the other leg, each movement being assisted.

The *third phase* begins when the patient take a step without assistance. He may still be in braces, splints and crutches, but he has taken a step. This means that he has purposely thrown himself off balance, and then of his own will has regained balance. From now on the program is easier.

The *fourth phase* is begun when the patient can take many steps without assistance. Gradually less and less use of the appliances are made until finally the patient is walking without any braces, and then without crutches. If the joint can only execute a certain arc, cage splints are used to prevent exceeding the arc, otherwise there may be increase of the hypertonicity and athetosis.

Very little consideration has been given to the mechanics of the foot in cerebral palsy. The feet are the very foundation of the whole body and if these structures are at fault then the whole superstructure is at fault. No matter how well developed the routine may have been with the more proximal structures, malfunction of the foot will prevent proper gait. Frequently we find a patient doing very nicely until he is placed upon his feet. I have followed out the work of Scherb by using a treadmill. Palpation of the muscles in gait will give a very important inkling as to action and timing. Indications can be based upon the proper deductions from these findings as to the efficacy of the foot as a whole and the necessity for certain types of operations.

The treadmill not only forms an important means of investigating the kinetics of the foot in gait but also a unique method of educating the cerebral palsy patient as to the proper method of gait. There is opportunity of instituting assisted movements while the patient is actually walking which is not possible in pool work or with any other type of muscle education. If the heel of the foot cannot be brought down on the ground in mild cases, assistance from the hand of the attendant can bring it down gradually. In treadmill work the support should not be too low. If one is using parallel bars or the various perambulators, it is important that the supports be placed high up, at about the level or just below the axilla. There is an inherent tendency for the spastic athetoid to bend forward at the hips. If he has worn long leg braces, then this has been accentuated. Right from the very beginning the extensor muscles of the back must be given due consideration so that the line of vision will be directly ahead of the patient.

As the patient develops walking on smooth surfaces or on the treadmill, resistance is offered to motion by having him walk in sand troughs. One can use inclined planes or planks of wood or have him walk on rough surfaces or coir matting. These sensory impressions are linked up with proprioceptive sensations, reinforcing them, and the whole regime linked up with definite movements. The patient may be able to walk on the same horizontal plane but unable to walk up or down steps. This requires much more coordination and is the first step to resisted and complicated movements. The body weight must be distributed

evenly on each foot. In order to maintain balance he may have to walk with his feet spread far apart to give him a greater pedestal of support. As the patient develops, this is gradually narrowed.

Posture. Rule out effects due to deformities or contractures in the lower extremities. Aside from these secondary attitudes there are certain primary postural deformities dependent upon the balance of muscle power. The posterior muscles may tilt the body backwards. The anterior muscles may tilt the body forwards. The rectus abdominus on the one hand, and the gluteal and deep muscles posterior to the hip joint on the other, affect the rotation of the pelvic girdle. When these muscles have great tonicity there is decreased inclination. Laxity of these muscles allows increased inclination. The more horizontal the sacrum, the greater the lumbar curve.

In the very young the deformities are plastic and moldable. For this reason it is most important to begin treatment early. If treatment is delayed, contractures and deformities develop. It is difficult to get the younger patient to relax but essentially the same procedures are followed. In carrying out passive movements I strap the patient to the table or have the assistant hold the patient on the table. The swing is in such a direction as to stretch overactive muscles. This stretching should be gradual and sustained. Work in all directions, correcting existing deformity. Visual, auditory and proprioceptive impulses are correlated with movements, then assisted active movements can be introduced. The assistance is removed gradually and resistance applied. The introductory treatment is with the patient in the recumbent position. As he graduates from this and is allowed to sit up, the same problems are met with in a similar fashion. Gravity is always made an assistant in the introductory work. One should never institute passive movements without preliminary measures to enhance relaxation. Passive manipulations of the trunk require no force. The movement passes through only that arc which the relaxations of the antagonists will allow without producing further spasm. This arc, although small at first, will increase gradually. The patient is then asked to tense those muscles which will assist with the movement at the same time keeping the antagonists relaxed. This may be assisted by having one hand on each group of muscles. Pressure is applied to that group which is to be active, and the pressure relaxed on the other. This active motion should first be assisted and pendulum-like in character, the body of the patient being supported by the masseur, with one hand on each group of muscles.

It is unnecessary to go into the details of braces and other supports. In hypertonic muscles they are not particularly indicated. In spasmodic torticollis they are detrimental. In certain hypotonic muscles, braces are very valuable.

If treatment is started while the muscles are still plastic, contractures can be prevented. If severe deformity has developed, then a much more difficult problem is at hand. In this, however, essentially the same principles of treatment are instituted.

GYMNASTIC WORK

Introduction. There is much controversy over gymnastic work since its exact objective has not been realized. Gymnastic exercises are not the cure of cerebral palsy, just as lengthening of the tendo Achillis is not the cure. It is senseless to expect a patient to undertake gymnastics who has not had a long and successful preliminary course of treatment along the lines indicated. Slipshod gymnastics are harmful.

Music has great value in gymnastic work. Slow, dreamy (legatto) music is best. Modern jazz is more apt to produce tenseness and increased irritability. Metronomes, marches, slow dances or postural movements aid in acquiring balance and grace.

Actual Gymnastic Work. The child is not forced to perform exercises immediately. I have him spend several weeks merely watching a class in action. I prefer not to have more than twenty patients so that individual instruction may be given. Not only spastics but infantile paralytics, scoliotics and arthritics are in the class. Each develops his own initiative to join. He sees both beginners and advanced pupils so that he has a chance to observe the exercises performed faultily and well.

It is important to develop the vital capacity since the cerebral palsy child has not learned how to breathe. Breathing-in as well as breathing-out exercises should be started first. In the beginning the exercises are performed lying down so as not to require weight bearing and balance. The particular exercises stressed depend upon the muscle analysis. As equilibrium improves, remedial exercises are instituted for balance. This has to do not only with standing but with walking, run-

ning, twisting, bending and turning. One follows essentially the same principles of gradation in effort with assisted, unassisted and resisted exercises. As the work in balance progresses, one can use various apparatuses. Swedish gymnastics are excellent, but in this country one is more apt to become interested in sports.

The great mistake being made in gymnastic training in cerebral palsy is to expect too much of the patients. They develop much more slowly than normals; they are fatigued very readily and find it difficult to concentrate too long on the same routine situations. For this reason it is much better to encourage sports or occupational therapy. Another great error is to stress their psychological and educational training. If for the greater part of the day they study, and at night when they are tired, physically and mentally they go through their exercises in a perfunctory manner, the result is that the patient does not progress. Not only that but he may attempt to get all he can into the twenty minutes of exercises he does at night. Instead of improving his status he becomes all the more fatigued. The psychologist in analyzing the situation blames the gymnastics. It is not that the gymnastics were incorrect but that they were taken in an incorrect manner. It is unnecessary to go too much into detail in gymnastic treatment since that is so well known to all of you. I find that the more simple methods are the most efficient. I use simple apparatuses consisting of wall ladders with weight and pulley systems, row-boat effects and various table devices.

Under Water Gymnastics. So much publicity has been given pool work that it is not surprising that attempts should be made to utilize it in cerebral palsy. Poor results have been universally achieved because procedures have not been carried out correctly. It is not necessary to have an expensive pool. The ordinary Hubbard tank lends itself much more easily to this type of work. The masseur can be at the side of the patient and institute proper massage and manipulations under water and guide the individual movements. This is much to be preferred, especially for the younger children.

Before being subjected to underwater therapy the child should have had some training in relaxation. He is introduced gradually to the concept of immersion in water. He is brought to the pool and allowed to see another receiving treatment. He is not forced, and it may take several weeks before he will allow himself to be brought near the water. During this time the other measures can be carried out. At first only his feet are put into the water, then more and more of his body is submerged until finally the entire body can be under water. This may take much time and patience. If the water is too cool there will be increase in rigidity. There are two beneficial effects from water. The warmth of the water encourages relaxation. The buoyancy of the water prevents the stretch reflex from being invoked as readily. The best temperature is from 98 to 100 F. If the water is too warm or if the duration of the treatment is too long there is a feeling of lassitude and tiring. If the pulse becomes high or irregular the patient should be removed from the tank.

If a pool is used one should take care that other children should not be present at the time of treatment. Splashings from other children will lower the morale of the child. The attendant should be near the child at all times, not only because of danger of the child falling off the plinth but constantly to be aiding the child.

When the child is placed in the water, do not start movements at once. Allow five to seven minutes to elapse so that some relaxation may be induced, then institute massage and relaxed movements. Exactly the same methods of massage, relaxation and relaxed passive movements are used in this work, then assisted movements may be instituted. Gradually the child is taught to develop his vital capacity so that he can stay under water for longer periods of time. Floating is a most difficult exercise since perfect and complete relaxation is required. When he has learned to float, and this may take months, he is in a position to perform coordinated, active movements which at first are unassisted and then resisted.

Indications and Contraindications. Not all cases are suitable for underwater therapy. Some children have such a fear of the water that they are much better off in the gymnasium. The pure spastic does best. The cerebellar cases do very well. On the other hand the athetoid and myasthenic type do much better in the gymnasium. Patients who are in the hyperirritable stage should never be subjected to pool work, at least until conservative measures in the gymnasium have done much to relax them.

As has been stated the Hubbard tank is

much more useful in the treatment of early cases. For older cases or larger patients who are developing the sense of equilibrium, the pool is very useful. The patient may be helped up on his feet, and although unable to stand outside of water may be able to stand in the water. Light metal splints may be used as supports. When the patient has developed to the stage where he can do swimming movements the pool is much more useful.

Underwater gymnastics are very valuable as adjuncts in treatment. There is the same necessity for preliminary training, and the methods of underwater gymnastics resemble those out of water. There is the inhibition of increased motor spasm, the selective inhibition of sensory stimuli and the correlation of visual, auditory and proprioceptive impulses with definite movements.

OCCUPATIONAL THERAPY

Definition. The term is rather vague since it includes any activity or occupation which may be used for remedial purposes. As such it must be controlled, and particularly is this true in cerebral palsy.

Advantages. Since these movements are purposeful they are even more readily carried out than any form of gymnastics, and they take away the staleness in training. The value of movements is demonstrated. Occupational therapy as it is usually applied is ridiculous from the standpoint of efficient treatment. In one of the finest occupational therapy shops in the country I observed a spastic individual left in the background. Instead of there being individual instruction so as to follow out essentially the same principles as we have laid down, other individuals were allowed to do the major portion of the work. The reason for this may be that the products made by the patients were to be sold. There can be no commercialization of occupational therapy in cerebral palsy. It is much more important that the correct movements be instituted than that the article made should be an object of art. Exactly the same principles hold in occupational therapy as in any form of gymnastics; in fact it is a form of gymnastics. The patient is not simply put to work, but before beginning occupational therapy, he should have a preliminary period of training in the usual routine. In my clinic the patient is first given heat, massage and relaxed movements before going directly to the continuation of his project from day to day.

Timing Factor. It is not necessary to wait for occupational therapy work until a patient has reached a certain age group. We begin our work in the preschool period. It is during this time that so much can be done in building up ideational concepts, correlating visual, auditory and proprioceptive sensations with certain movements. In this the use of legends and stories form a most excellent psychological aid.

Toys. The use of toys is an excellent means of introducing simple movements. It is beyond this treatise to analyze the principles used in the selection of toys or in the institution of games. They form most important adjuncts as long as one keeps within the capabilities of the patient. Only a few illustrations will be given of what can be done.

Blackboard work forms a very important aid, since not only does it give purposeful movements, but it is a means of developing speech. An ordinary blackboard is used, but the chalk is a little thicker than ordinary so that the child can grasp it more readily. At first the child will be unable to grasp it at all. The attendant helps by molding the fingers of the child around the chalk, and holding his own hand over all. With the attendant guiding all movements the chalk is made to inscribe on the blackboard. The first inscriptions have nothing to do with writing at all. Dots, dashes, straight and curved lines are made. The assistance is withdrawn gradually until the child can perform these movements himself. When he can do so, the work is continued along obvious lines. Each new movement is assisted at first.

A most useful measure which we have followed in developing function in one hand or the other is as follows: Two colors of chalk will be used. One for each hand. The child himself will choose which color is to go to each hand. If the child is left-handed and we wish to develop his right hand, we will let him make inscriptions with both hands. If he chooses the white chalk for the right hand and the red chalk for the left hand, at first a similar number of movements are ordered with both colors. Gradually the white chalk inscriptions will be required more frequently, as the child associates more and more white chalk with right hand movements. There is no forcing of the child, and there is no tying of the hand. Through the conditioned association of white chalk with right hand movements, the child is encouraged to use the

desired hand more and more. The various projects follow similar principles.

SUMMARY

An attempt has been made to present a proper clinical consideration of cerebral palsy. There is no cure for this condition but much can be done to lessen the incoordination of muscle action thereby bringing about functional capabilities. A working hypothesis has been developed so that we understand coordinated muscle action, and from this a well rounded routine of muscle education has been established. This forms the nucleus of all work. Many excellent contributions have been made and these have been correlated. It is not that surgery, whether it be orthopedic or neurosurgery, is not useful, but rather that it is only an adjunct in treatment. Psychology and psychiatry have a great deal to offer, but this merely has reference to the approach and is not the scope of treatment. The speech correction expert has an important role, but unless the patient is prepared for him, all his work will be of no avail. Too technical an approach, as can be had easily in occupational therapy, is of no value unless it is well correlated with the routine of treatment. Educational and vocational guidance must be harnessed in order to achieve maximal values from therapy.

General Survey of Circulatory Diseases with Special Reference to the Extremities of the Body

Frank M. Hand, M.D.

The reason for choosing the above subject is the important role played by the peripheral vascular network in so many conditions, and especially since it is through this system that the defense and protection against body injury and infection is maintained. This network is under the control of a very delicate and sensitive nervous and chemical mechanism as well as a sympathetic governor. This remarkable thermostat we push to the "nth" degree at times, and the unhappy result is a breaking down somewhere along the line.

Since man began to practice the art of healing, the circulation was an important part of it because pulsations could be detected by palpation. This, along with vision, taste, smell and audition, were the only methods known to man for diagnosis. It is interesting to note that since the early dark ages of medicine, beginning with Hippocrates 460 B.C., the circulation of the blood, though not understood, was one of the main themes of medical practice. In the fourth century Archimedes, who is remembered for his famous Eureka bath tub experiment for specific gravity, devised a number of hydraulic instruments as well as many hydrostatic measures for treatment of conditions that evidently were blood conditions. In the fourth century Herophilus, an Asiatic Greek, educated at the famous Alexandria University of Egypt, was the first physician who regularly dissected the body of man and systematically studied it. He was known as "The Father of Anatomy." He had no instrument corresponding to a watch but had a leaking water-filled glass cistern (clepsydera) of dubious value, yet he mastered the pulse beat in health and illness, and, therefore, was the earliest sphygmologist. It was he, Herophilus, who gave us the fol-

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lowing description:

"A goat rises from the ground by two actions. First there is a great heave of his hind legs followed by a lesser one of its forelegs."

There is a condition of the pulse in which the examining finger feels two beats, the second being weaker than the first. He called it the goat beat pulse (pulses capizans dicrotus) by which name it is still known.

Galen, the best educated and most gifted physician of the second century, and for many centuries to come, was born 130 B.C. in Pergamum in Asia Minor. Galen wrote seventeen chapters on the pulse.

After the fall of Alexandria in Egypt, and so for a number of centuries to come, a mysterious darkness hiding medical progress and learning seemed to cover the land. In the fifteenth century Leonardo DaVinci, so well known for the unforgettable smile which he painted on the lips of Mona Lecia Del Giaconda, began to draw very wonderful anatomical pictures from life itself but still did not have the true vision of circulation. Although there were many at the gate of success, it remained for William Harvey, an Englishman educated in Padua, to write in 1616 the true circulation of the blood. Just what he feared we do not know, but he allowed twelve precious years to go by before his work was published, and then it was published in a foreign country. It was then many years in all schools before his theory was accepted. The developments in later years are familiar to you.

From an orthopedic standpoint, according to Mr. Walter Mercer, a famous English surgeon, we will divide vascular diseases into:

A. Primary Vasomotor Lesion.
   1. Vasoconstrictor disturbances (Raynaud's Disease).
   2. Vasodilator disturbances.
      a. Acrocyanosis.
      b. Erythromelalgia.

B. Primary Obliterative Lesions.
   1. Mechanical (Embolism and Thrombosis).
   2. Inflammatory.
      a. Thrombo-angiitis Obliterans (Buerger's Disease).
         Specific arteritis.
   3. Degenerative Arteriosclerosis.

Only three of these diseases will be discussed:

(a) Raynaud's Disease,
(b) Thrombo-angiitis Obliterans, and
(c) Arteriosclerosis,

conditions which we do encounter in everyday clinical and private practice.

Raynaud's Disease

Raynaud's disease may be said to possess the most definite clinical entity of any of those mentioned above. Structurally it is a condition of the young, since most cases occur between the ages of 18 and 30 years. Women are more commonly affected than men. Exposure to cold is considered a causative stimulus for this condition, although occasionally it may be emotional disturbances. It runs an intermittent course, usually is symmetrical, affecting the hands or the feet. The attack is inaugurated by a blanching of the fingers at first appearing at the tips of the digits and then spreading proximally. There is a dull ache which is painful. This stage or period of pallor is known as a stage of local syncope and is succeeded shortly by asphexia in which the whole hand becomes swollen and cyanotic. Anesthesia and paresthesia follow. If there is no improvement in the circulation, tips of the fingers, toes and ears become dark and necrotic. From the standpoint of pathology it is assumed that the underlying cause is an intense vasoconstriction of the smaller arterioles. There is a momentary relaxation after the first stage which allows some blood to escape into the capillary bed which has dilated due to an over production of "H" substance. The blood being deoxygenated, the parts appear cyanotic. There is normal pulsation in the arteries during an attack. Actual extensive gangrene is rare. The gangrenous ulcers are pinched-out areas. The temperature of the extremities remains low. There is an absence of rest pain.

Thrombo-angiitis Obliterans

For our purpose in this entity as well as in arteriosclerosis, clinical manifestations are much more common in the lower than in the upper extremities. Posture plays a part, toes becoming red or cyanotic when dependent, and white or blanching when elevated. The symptom of intermittent claudication usually is prominent. Pulsations in the main vessels of the extremities often are en-

tirely lost. The classical description of this disease was made by Buerger in 1908, and his name is still associated with the condition. It is said, and quite often seems true, that this condition commonly is found in Russian Jews and the Jewish race. It is thought that there is some connection between this and the excessive use of tobacco. It most often affects those 30 years or older. Pain is a very prominent symptom in this condition, especially on excessive use of the extremities. This pain is relieved by rest. Trophic changes ultimately appear in the form of superficial ulcers. Some of these ulcers refuse to heal, and dry gangrene ensues. Frequent cramping pains as well as intermittent claudication are numerous. As the disease progresses pain is not relieved by rest or from acquiring narcotics for relief. Buerger believes that some specific infective or toxic agent is a forerunner or cause of the disease, but definite proof is lacking.

Pathology

As the name implies there is a progressive closure of the large vessels of the limb, arteries and veins both being affected. The occluding mass in the superficial (soft red thrombus) becomes converted into fine yellowish white granulation tissue which is permeated gradually by minute blood channels. The nearby nerves may be fused with the artery and vein in this tough fibrous mass. It has happened that due to collateral circulation the thrombosed vessel often becomes recanalized.

Clinical Course

Some of the earlier disturbances are cold feet, numbness, tingling, edema and pallor. Embolism and superficial phlebitis may occur about the site of the occlusion. The first stage is that of claudication due to anoxemia which manifests itself by abnormal and excessive fatigue or pain following exercise. Pain follows close on this first stage, and trophic tissue changes ensue, such as ulcers, fissures and gangrene. It is very slow in developing and sometimes requires five to ten years to establish these stages. The pain as mentioned usually is present on rest. It varies greatly in severity but is constant in its situation. In older individuals the two conditions of Buerger's and arteriosclerosis often work hand in hand, and with the lack of collateral circulation gangrene may come on at a very early stage in the disease. The condition nearly always is bilateral.

ARTERIOSCLEROSIS

This type of vascular occlusion is an accompaniment of old age and the patients are in very poor general health, differing from Buerger's disease in that the process is more uniform and not localized. The process, however, is sometimes slow and extreme measures may not be resorted to for several to ten years. The process is a degenerative one rather than an inflammatory or neuro-circulatory condition. The elasticity of the vessel wall is lost. Fat is deposited, hyalin fibrosis sets in and this is soon followed by calcification. There is no elevation of the blood pressure. Pain is a prominent symptom.

Treatment

With the advent of the oscillometer, the thermocouple, the artificial fever apparatus, the pavex and intermittent venous occlusion machine, as well as a number of other devices, we have been a little more effectual in the last few years in the handling of these conditions. First of all a very strict routine has to be outlined for the patient. Diet must be regulated. Diabetes, if present, must be rigidly watched and controlled. Rest periods or complete rest must be had. A maintenance temperature of 85 or 90 degrees with the aid of such devices as cradle, heat lamps may be used. Contrast baths, hot packs, massage, elevation, exercises, foreign protein, injections of theomine chloride, large doses of vitamins, large doses of sodium chloride, large doses of calcium as well as the utilization of physical agents, are important.

ACROCYANOSIS

This condition resembles Raynaud's disease in its location, but there is an absence of the blanching and other features known as syncope. Paresthesia and anesthesia occur that do not correspond to any nerve distribution. There are trophic changes in the skin and bones localized to the fingers and toes, and a chronic progressive condition, not paroxysmal in character.

Erythromelalgia

This is an infection described by Weir-Mitchell as being characterized by the proximal occurrence of pain, redness and swelling of the hands and feet. Hyperesthesia, motor, secretory and trophic disturbances, also occur. It occurs at periodic intervals. During an attack the feet are tensely cold. Skin acquires a bright red color. Attempting to warm the parts gives them a feeling of swelling, fullness and throbbing pain. If affecting the feet they may not be able to keep them covered during sleep. There may be hyperhidrosis and it is not uncommon over the palms and the soles of the feet. Blebs, thinning or atrophy of the skin and dystrophies of the nails and hair may occur.

Conclusions

Arterial disease which affects the extremities is more common than is thought, due in great part to our mode of living. Coronary disease is more frequently in the higher types of business and professional men. Example is the high tension pace we lead, rich food, alcohol, lack of regular exercise, lack of mental relaxation. The circulation of the blood, physiologically speaking, depends on a number of factors as follows:

1. The pumping action of the heart.
2. The volume of fluid.
3. The viscosity of the blood.
4. The peripheral resistance (arterioles and capillaries).
5. The velocity of flow in the vessels.
6. The vasomotor system.

The life of a blood vessel depends upon its innervation, its intrinsic muscles and the extrinsic muscles that account for our daily activity or metabolism in that part. The blood pressure of a patient is very variable, and the blood pressure in the lower extremities being higher than in the upper is likewise variable and depends to a great extent upon the age of the individual. The muscular development and the type of life whether sedentary, outdoor or athletic activities are a part of the daily routine and influence blood vessel walls. Much can be done for the mild arterial disease patient if he can be studied in the earlier stages. Blood pressure, diabetes and control of the nervous system can be benefited by well planned and systematized therapy. Physical therapy is a necessary adjunct to the usual regime. Surgery for the case that is beyond conservative help is most advisable. Orthopedic measures such as supports and braces are useful. Resection of sensory peripheral nerves may be necessary in the aged individuals with intractable neuritic pain. Genuine cooperation between all branches of medicine and surgery is absolutely necessary. By combining all of these measures mentioned above much suffering and anxiety can be alleviated. You may save a limb, and you may save a life.

Catlin gives a good description of the typical sweat bath as he saw it employed among Mandans about 1832. All Mandan villages had a special tepee set up near a stream. Each family lodge had among its appointments a crib or basket of reeds, large enough to hold any member of the family in a sitting position. When any member of the family wished to take a sweat bath, the squaw carried the crib to the sudatory. Inside the sudatory were two stone walls 6 ft. long, 2½ ft. apart and 3 ft. high. Across the top of the walls rods were laid and the crib placed on these. Close by was an oven in a bank where stones were brought to a red heat. The patient or bather arrived, naked except for a blanket, and squatted in the crib. The squaw then brought in the stones, using a forked stick to handle them and placed them below the crib. She next doused the stones with cold water and then tightly closed the tepee. As soon as a profuse sweat occurred the bather emerged and plunged into the stream. This was followed by a brisk dry rub and a return to the family lodge where a long nap, under many robes, was taken.—*From "Medicine Among the American Indians," by Eric Stone, M. D.*

Splinting of the Shoulder Girdle for Anterior Poliomyelitis

Robert L. Carroll, M.D.

To find the most neutral position, considering all muscles of the shoulder girdle, the normal range of movement of the scapula must be determined first. The old teaching that the first 90 degrees of abduction of the arm occurs in the scapulohumeral joint without movement of the scapula, and that the last 90 degrees occurs by a rotation of the scapula is still found in textbooks and even current ones still show the arm at right angle to the body with skin markings to show there has been no rotation of the scapula, whereas others show the rotation of the scapula to begin before the arm reaches this point. On careful physical examination it is very easy to see that in the first few degrees of abduction of the arm the movement is entirely in the shoulder joint and at about 45 degrees of abduction the inferior angle of the scapula is seen to begin to move outward. X-rays of the scapula in these movements are even more conclusive.

X-rays of a child, aged ten, were taken in the following positions: (1) with arms at the side in neutral position, (2) approximately 45 degrees abduction, (3) at right angle abduction, (4) about 135 degrees of abduction, and (5) the final picture approximately 180 degrees with arms straight overhead. (See Fig. 1). These x-rays were made with active movement in the standing, and passive movement in the lying position. X-rays of an adult were made standing in the same position, with active movement. The arc of movement was then measured on the x-rays, after being lined along the vertebral border and the spine of the scapula, and the angles made with the vertebral column were then measured for each side in each different position. These measurements were made right and left and the average was taken. Whereas it was found almost impossible to get the arms at exactly one-fourth movement each time, the positions were approximately the same and the measurement of similar angles were approximately the same. As seen in the x-rays there was but little movement of the scapula in the first quarter of the arc of movement. During the second and third quarters of the arc of movement most of the rotation of the scapula was accomplished, leaving but very little, and for practical purposes no movement in the final quarter, practically all of this movement being made by the humerus itself. It was found that the scapula rotates approximately 60 degrees and that this range of movement occurs as above stated, leaving 120 degrees of movement of the arm, the most of which occurs during the first and last quarters of movement.

After the diagnosis of acute poliomyelitis is made and before any definite paralysis is shown, splinting is indicated and the question naturally arises as to what group of muscles should be favored. This can be answered easily by favoring the antigravity muscles, which are the ones most frequently seen definitely and many times permanently weakened in the residual paralysis. It is impossible to put at maximum rest all of the seventeen muscles that have at least some part of their origin or insertion on the scapula. Hence the antigravity ones to receive first consideration are the supraspinatus and deltoid for the shoulder and the mid-trapezius

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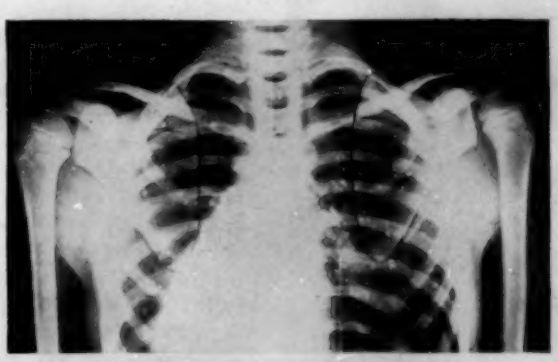
Read before the Western Orthopedic Association, Seattle, Washington, 1937.

and rhomboids for the scapula. With the arm at right angles the deltoid is well relaxed, but as seen in the x-rays of the movement of the scapula in a normal individual approximately half of the rotation of the scapula has occurred with the arm at right angles or approximately 30 degrees of rotation, which of course would put a definite stretch on the rhomboids especially. Hence the rotation of the scapula should be lessened and with the arm at approximately 75 degrees of abduction the most of the movement in this position is in the scapulohumeral joint, thereby partially relaxing the rhomboids without adding considerably to the stretch of the deltoid and supraspinatus. With the arm in abduction it was noted by some of the physicians in working out this problem at The Orthopedic Hospital that the point of the shoulder was rather high and that pressure on the acromion would decrease the rotation of the scapula while the arm was held in approximately the same degree of abduction from the body. This was accomplished in two ways: one, by putting a strap over the shoulder with weights over the end of the bed sufficient to hold the shoulder in the proper place and another by making a padded adjustable metal support, fastened to the top of the Bradford frame to push against the acromion with foot of bed slightly elevated (Fig. 2). X-rays of patient (Fig. 3), with such pressure over the shoulder, show the rotation of the scapula to be decreased approximately one-half. Hence it is possible to maintain approximately 75 degrees abduction of the arm with but little rotation of the scapula as shown by x-ray with such pressure applied over acromion (Fig. 3).



In the convalescent stages, especially after the atrophy is apparent, a definite tendency toward anterior sub luxation is seen and by raising the arm forward about ten to

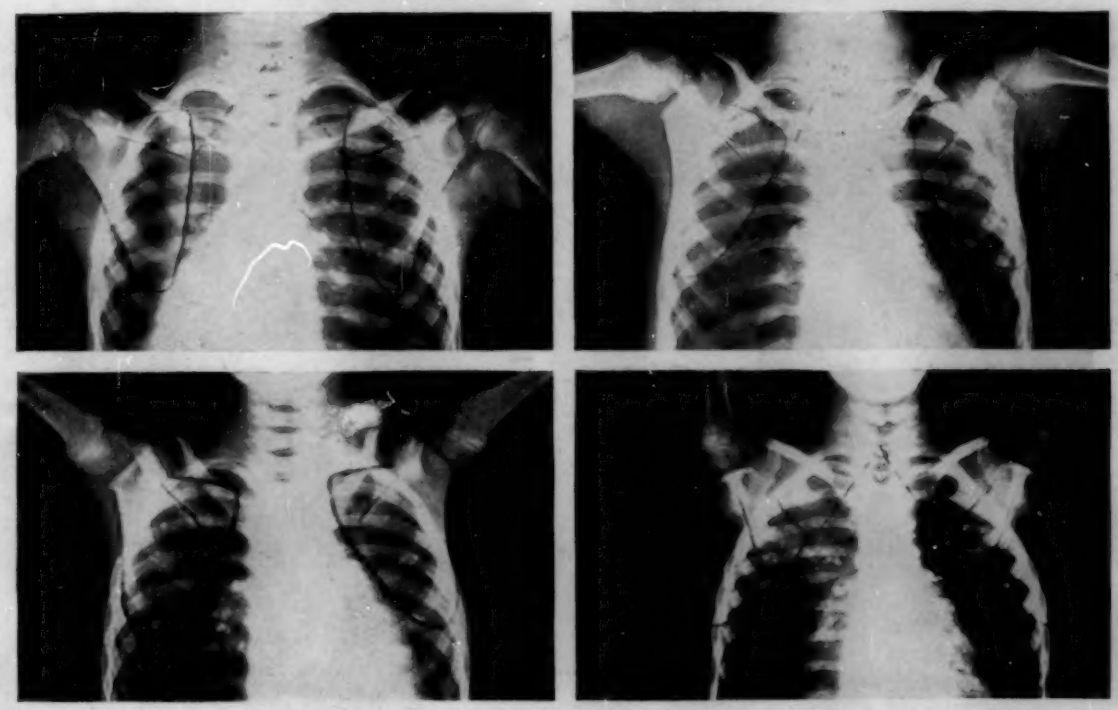


Fig. 1

Fig. 2

fifteen degrees, this condition is relieved by putting pads under the distal end of the arm and elbow (Fig. 4).

In the convalescent stages, especially after the atrophy is apparent, a definite tendency toward anterior subluxation is seen and by raising the arm forward about ten to fifteen degrees, this condition is relieved by putting pads under the distal end of the arm and elbow (Fig. 4).

In the standing position the arm tends to rotate inward and the internal rotators of the arm are stronger than the external rotators, hence it is indicated to keep the arm in at least moderate external rotation. Likewise extension of the elbow is favored by gravity and to relax the biceps the elbow is flexed to a right angle. Also the forearm is usually held in pronation, hence it is put up in a splint with moderate supination and in bandaging the arm to the splint (Fig. 4), it is very easy to bring the bandage in a direction to relax the opponens muscle of the thumb. If the fingers are involved they can be bandaged easily in neutral position, or if not involved an adjustable hand grip is found to be useful and comfortable. By use of a wire splint made with a triangular base (as shown

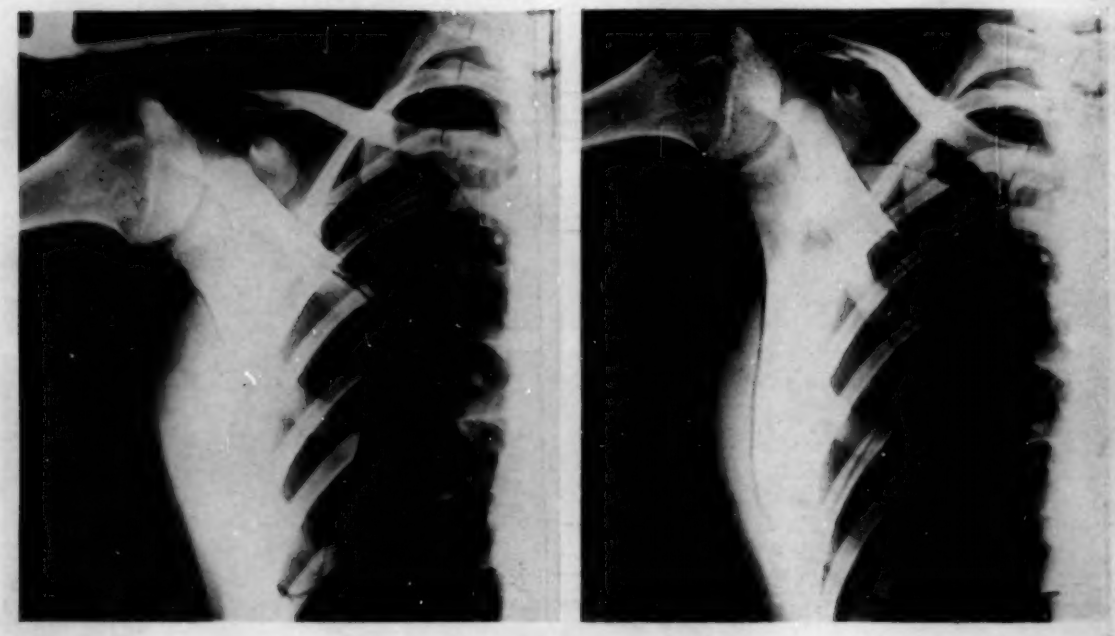


Fig. 3

A. With shoulder pressure. *B. Without shoulder pressure.*

in Fig. 5), which can be slipped between the mattress and the boards upon which the mattress rests to make a hard bed, the above positions can be maintained, or if a Bradford frame is desired similar adjustable splints can be attached easily (Fig. 6), which hold the upper extremities in a much more secure position than can be obtained by use of pillows which almost invariably allow the wrist to flex rather acutely. These splints, on either the bed or the Bradford frame, are easily and quickly adjusted to the necessary position and hold the shoulder girdle and upper extremities in what appears to be the optimum position, certainly for the early stages and so much so for the later convalescent stages that it is the position most frequently used with slight variations in individual cases as necessary.

SUMMARY

In complete abduction of the arm approximately one-third of the movement is accomplished by rotation of the scapula. Though the humerus moves some with the scapula the most of the movement in the scapulohumeral joint occurs in the first and last quarters of the arc of movement.

In poliomyelitis before the paralysis is evident, the optimum position for splinting of the shoulder girdle appears to be one which favors the antigravity muscles with the arm abducted approximately 75 degrees from the body, about ten to fifteen degrees forward from the lateral midline of the body, rotation of arm to neutral position with the elbow at right angles, the forearm in moderate supination and the wrist and fingers in neutral position. This same position is also found useful for the majority of cases in the convalescent stage.

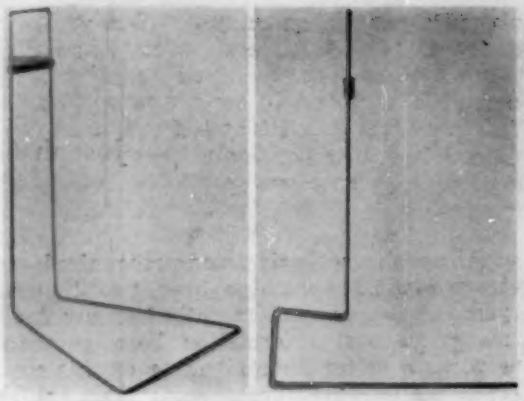


Fig. 5

Fig. 4

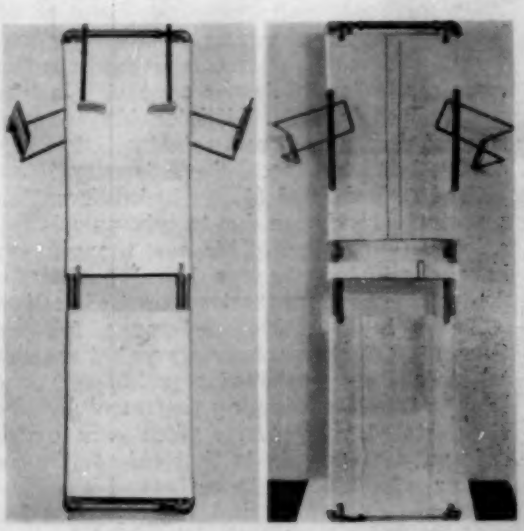


Fig. 6

Scoliosis

Joseph C. Risser, M. D.

Although scoliosis was recognized and treated by Hippocrates over two thousand years ago, only until recently has any fundamental factual information been gained to give us a better understanding of this condition. In 1864 Brodhurst[1] said: "Few subjects in surgery are perhaps less understood, and none more abused, than this of curvatures of the spine." At this same time Little[2], after whom Little's disease was named, wrote: " . . . in no department of medical practice has the good been more checkered with evil than in books relating to spinal curvature.... In no branch of medicine has charlatanism on the part of legal practitioners of medicine, and illegitimate ones, been more rampant."

At this time they had accumulated the knowledge that scoliosis was not a fracture dislocation as was believed by Hippocrates.[3] They realized with Ambrose Pare[4] (1510-1590) that a metal support following traction would relieve symptoms and perhaps hold some correction while the support was being worn. Yet in 1868, Little[2] said: "A spinal support does not correct rotation but is often a mere blind to conceal the deformity."

Sir Percival Pott[5] (1779) had differentiated a posterior deviation due to tuberculosis from a lateral curvature. This new thought must have eliminated the rye bread poultices of Andry's[6] time from the treatment of scoliosis.

Henry Ling (1800) of Sweden, following Glisson[7] (1671), strongly advocated exercises to strengthen weakened muscles. And yet Roth[8] (1889), supporting treatment by exercises, stated that: ". . . when once osseous deformity had set in to that extent, the case is now acknowledged to be incurable by leading surgeons." Exercises of various and ingenious types, with apparatus and in many positions, were used. Adams[9] (1865) believed with Lonsdale[10] that exercises were preventive rather than curative.

At this time there was a belief by some that the scoliotic deformity was associated with growth. In 1824, Bampfield[11] observed that scoliosis was due to increased growth on one side of the vertebral bodies with progressive absorption from pressure on the other. Adams,[9] in 1865, said that increase in curvature might occur at any period of life from failure of general health, or from local causes. On the other hand, he stated that: ". . . there are mild curves notable between the ages of twelve and sixteen which yield abundant cures under any treatment."

The principles of correction were primarily parallel head and pelvic traction, with lateral pressure over the rib prominence. Lateral bend was introduced at this time, first as a couch or bed treatment. But Guerin,[12] in 1839, used this principle by strapping the patient to a hinged board and gained correction by bending against the curve.

With the introduction of the plaster body jacket by Lewis Sayre,[13] in 1875, new ideas in correction were used. Calot[14] added the headpiece. Wullstein[15] used traction force up to 200 to 300 pounds. This was done under anesthesia by Ridlon.[16] Jackets were applied in different positions under horizontal traction and lateral pressure; prone by Lovett,[17] supine by Goldthwaite, suspended laterally by Rich,[18] supine forward flexed and twisted against the curve by Abbott,[19] while Forbes[20] twisted with the curve. Recently in 1913 Galeazz[21] introduced the prone position, lateral bend, traction, lateral pressure sling and torsion of shoulder girdle on the pelvis.

Truslow[22] sectioned the cast following application and manipulated by torsion or bend to get correction. Felt and pneumatic pressure pads were incorporated or later added to the jacket. And Steindler[23] added a hip spica to the jacket to aid in gaining a compensatory lumbar curve.

Hagland believed in self correction of a right dorsal curve by application of a jacket, listing the spine to the left obliterating the compensatory curve. Any attempt to straighten up on the part of a patient would be corrective for the right dorsal curve.

Emphasizing the principle of lateral bend

Orthopedic Surgeon, 1930 Wilshire Blvd., Los Angeles, Calif.

in correction of scoliosis, in 1920 lateral hinges and a turnbuckle were incorporated into the jacket thus gaining a maximum of traction and a minimum of lateral bend. In 1927 it was realized that more lateral bend would gain better correction, and so the hinge was placed front and back approaching the center of the body and superimposing the convexity of the curve which is eccentric to the body. In this manner traction was lessened and lateral bend increased giving us oblique traction of Guerin.[12] A hip spica was added on the side of the convexity to help distribute the pressure necessary to fix the pelvis.

After three to five days of drying, the jacket is cut through on side of the concavity and a turnbuckle is inserted. On the opposite side of the jacket at the level of the hinges, a window is made which allows a space into which bending can take place. As gradual bending by means of a turnbuckle continues from day to day, the combination of traction and lateral bend determines correction. Lateral external pressure, which is the chief obstacle in thoracic curves, is replaced by compression of the body as bending continues.

Correction of lateral curvature by whatever method used is dependent upon the motion present in the area of curvature. Thus, correction of upper thoracic curves will be less than in dorsolumbar curves. It also follows that maintenance of correction is dependent upon the elimination of motion in the area of curvature. This was accomplished surgically by Hibbs[24] in 1911, on tuberculous spines, and in the scoliotic in 1914. His object at that time was to prevent increase in deformity by spine fusion thus eliminating motion through which increasing deformity might occur.

When fusion is contemplated it should be done with the curve corrected, and the spine compensated as well as possible. This is best accomplished by the combined effect of horizontal traction and lateral bend or oblique traction, which reduces the size and length of the curve and its associated rotatory deformity to a minimum, and increases the adjacency and length of the compensatory curves. In mild and mobile curves, complete correction of the lateral curve and its concomitant rotatory deformity is obtained. The severity of the structural changes and lack of mobility in the curvature will limit the amount of correction.

And so, in this anterior-posterior hinge turnbuckle jacket a fusion is performed through a posterior window following reenforcement, thus preventing loss of correction. Three months later this corrective bent jacket is removed, x-rays taken, and a semi-bent ambulatory jacket is applied in the bent position of correction. One or two similar changes of jacket are made, allowing a total immobilization period of six to twelve months.

Failures to maintain correction are due to too short a fusion area, incorrect fusion area, or a pseudarthrosis in the fusion area. Too long a fusion area may produce an opposite deformity.

Fusion should be advised only when we might accomplish for the improvement of the patient:

1. Prevention of increasing deformity.
2. A curve which is severe enough for any particular patient that justifies correction.
3. To eliminate pain.

If these indications are followed, over 75 per cent of curvature cases coming for treatment should not be treated by fusion. Many scoliotics come for examination after there has been an arrest of the curvature. This occurs naturally with cessation of vertebral growth, which in the female is an average of 14½ years (13-16), and in the male 16 1/3 years (14-17). Determination of this fact, in the doubtful case, is accomplished only by a study of comparative height measurements and x-rays in comparable positions. Again there are adult cases with severe deformities with little correctibility and no pain.

This large latter group are benefited by physical activity which will improve muscle tone, localize blood supply, and result in general feeling of betterment. Correction of a structural scoliosis by exercises must be associated with vertebral growth. In recent years this has been accomplished in three babies under one year of age with structural curvatures. Aside from the dietary care, treatment consisted of twenty-four hour face-lying, which encouraged voluntary hyperextension muscle activity. No attention was paid to asymmetry of muscle action. In all three cases complete correction of a structural curve and a strong back was obtained under two years of age. This idea strongly recommends itself for use in older cases not yet through growing.

This idea of hyperextension spinal activity is being used in connection with bent and semi-bent ambulatory jackets, plus supportive medical and dietary care. It is necessary that

these cases be fully corrected at the crest of the curve and be held corrected until vertebral growth ceases. It is too early to estimate results on these cases at present.

Our knowledge at present consists of the following:

1. Correction of structural curves can be accomplished depending on the amount of motion present in the area of the curve.
2. Correction can be maintained by eliminating this motion by means of fusion.
3. Fusion will relieve pain.
4. Scoliosis is arrested with the end of vertebral growth.

This present knowledge of scoliosis does not solve the problem but merely allows us to define the question in a better way.

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Chronic Arthritis

Charles LeRoy Steinberg, M.D.

Until quite recently the medical profession paid little attention to the diagnosis and treatment of chronic arthritis. As a result the sufferers of this disease appealed to the various cults for aid. However, this situation is being overcome rapidly by means of the educational efforts of the American Association for the Study and Control of Rheumatic Diseases.

Arthritis or rheumatism is not a clinical entity but comprises a group of many diseases. It is as difficult to define as the term allergy because it has very doubtful boundaries and subdivisions. It is also difficult to classify this disease because of the many factors which enter. In many instances the joint symptoms are merely part and parcel of some other constitutional disease. To illustrate: Undulant fever is associated with a very severe joint symptomatology. The same is true of the leukemias and of Hodgkin's disease. Again certain definite diseases are complicated by arthritis; this is true in the case of gonorrhea, dysentery infection and typhoid fever.

This discussion, however, is limited to the two main types of chronic arthritis: Atrophic and hypertrophic arthritis. Atrophic arthritis usually attacks individuals between the ages of 20 to 40. It may attack children and is then known as Still's disease. It may be limited to the spine and is then called Marie-Strumpell Arthritis. Its onset may be gradual, or it may be acute and simulate rheumatic fever. It has various synonyms: Rheumatoid arthritis, proliferative arthritis. It attacks females to males in a ratio of 4 to 1. It

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is considered to be infectious in nature. Streptococci or their products may be intimately associated with its cause. It is this type of arthritis which goes on to ankylosis with complete joint destruction if the process is not stopped. The pathological picture consists of a proliferation of the synovial tissue of the articular cartilage. There is also a proliferation of the connected tissue elements of the bone marrow in the subchondral bone region. This causes complete destruction of the articular cartilage with replacement of fibrous connective tissue elements. In the synovial tissue focal collections of lymphoid cells and fibroblasts are found. This proliferated tissue is quite rich in new blood vessels.

Hypertrophic arthritis usually attacks individuals past middle life. It is slightly more common in females than males. It is considered to be degenerative in nature. Trauma, age, and the menopause are considered to be accelerating factors. Its synonyms are: osteo-arthritis, arthritis deformans, degenerative arthritis. When it attacks the terminal interphalangeal joints, the resulting deformity is known as Heberden's nodes. The pathology consists of a fibrillation of the cartilage. There is also a rearrangement in the size and shape of the cartilage cells. There is irregular production of bone tissue. The trabeculae become thickened and the narrow spaces become obligerated. It in itself results in no ankylosis. It may be entirely asymptomatic.

Treatment

Rest is paramount. If the condition is sufficiently acute or severe, absolute bed rest is indicated. At the end of this period, rest intervals should be employed (similar to cardiac management). The removal of foci infection may be important. However, in many cases there is more than one focus and therefore the removal of the tonsils alone or the infected teeth alone will prove of no avail. It is also important to remember that even in health various types of streptococci are present in the air passages, the intestinal tract, et cetera, and they become pathogenic because of constitutional deficiencies in immunity rather than because of local factors. In rare instances the removal of a single focus will result in an absolute cure. Physical therapy in the form of heat, massage, and proper exercises when used properly are of unquestionable value. As regards diets it is important that the calories be restricted in the obese hypertrophic arthritics. Many of the atrophic arthritic patients are undernourished and in these individuals sufficient calories and sufficient accessory food elements should be given. Colonic irrigations cause more harm than good. Vaccine therapy when used properly may be of decided value in cases of atrophic arthritis but has no value in the hypertrophic group. Schilling differential counts and sedimentation rates should be done at frequent intervals, when vaccine therapy is employed, as an index as to whether the infectious process is subsiding. Iron, liver, and transfusions are of definite value when the blood picture is deficient. Thyroid may be of value in the hypertrophic group. Salicylates are employed to relieve pain, but since they deprive the patient of vitamin C their use may be of some harm. Gold salts have been used by some men but it is a dangerous drug. Massive doses of vitamin D therapy is still in the experimental stage. Vitamin B complex is of a definite value in improving the appetite, alleviating constipation, and restoring a normal tone to the intestinal tract.

In closing, "The physician should no longer be willing to ignore rheumatism, he should no longer be content with the sorry gesture of salicylates for his new, and spas for his old arthritic patients. His should be a more resolute inquiry, increasingly purposeful and critical. Something must be done—something is being done for the problem that is rheumatism."[1]

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1. Nelson Loose Leaf Medicine, Vol. 5, Thos. Nelson & Son, New York City.

Physical Therapy in Psychiatry

Clarke H. Barnacle, M. D.

In a broad sense "psychotherapy may be defined as anything a physician does for his patient"[1] and includes physical as well as psychological methods. Physical therapy is an important adjunct in the hands of the psychiatrist not only because it increases the physical well-being of the patient but because of its more subtle psychological aspects. Stimulative, sedative, and eliminative physical therapy through sheer physiological effects are definite aids in the management of psychiatric problems, though in a more liberal sense the patients benefit by such treatment because of the psychological factors. This thought has been well stated by W. M. Menninger and M. Cutrer. "In every instance the psychologic situation in physical therapy furnishes two extremely important aides in helping the patient to get well. In the first place the patient can see visibly that something is being done for him. The procedure, whether it is a bath or massage, ultraviolet light or an electric cabinet bath, impresses him because it is physical and because it comes in direct contact with him. Thus it means to him a direct approach to his physical self. Secondly, physical therapy is effective in part because the patient becomes the center of attention in a very real way in receiving the personal ministrations of the physician or technician or nurse, and thus it satisfies in any individual an unconscious desire for self-love."[2] William Menninger believes that there are at least three unconscious emotional needs that are satisfied by physical therapy in certain patients;[3] first, the unconscious need for love; second, the wish for self-esteem; and third, the desire for punishment. It is well recognized by psychiatrists that psychoneurotics have a strong need for attention, love and affection. We note many individuals who compensate for feelings of insecurity and inferiority by "building themselves up" physically. Physical therapy is then a form of reassurance—a definite mechanical method of combatting their fears. Depressed patients frequently are preoccupied with intense feelings of guilt and thus they demand some form of punishment. Cold wet packs and continuous tubs may relieve these intense feelings in certain individuals.

Physical therapy should not be prescribed routinely to mental patients. The responsibility for its prescription should rest only with the physician, who has an adequate understanding of the personality problem. While in general, patients suffering from similar disorders may react favorably to physical therapy, the problem always is an individual one. "Like our most potent drugs, hydrotherapy is a 'two-edged sword.'"[4] Forced continous tubs or packs may excite a manic patient to open rebellion. Physical therapy may overemphasize the psychoneurotic's physical complaints and lead to intense preoccupation on his symptomatology, avoiding real psychiatric treatment of his abnormal state. The success of the treatment is dependent upon the knowledge, skill, and understanding nature of the physical therapist. It is the psychiatrist's duty to give the physical therapist a general formulation of the patient's personality problem. With this in mind the therapist should assume an objective attitude toward her patients throughout the treatments, avoiding too great a display of sympathy but at the same time being friendly, encouraging and understanding.

In the treatment of "excitements" the general principle is sedation; that is, cutting down all stimulation. The "excited" patients include manics, certain schizophrenics, epileptics, toxics and organics. The most effective sedation for the "excitements" is continuous tubs, warm needle sprays, fomentations and Scotch douches. Cold wet packs definitely may be indicated but are to be avoided if the restraint element is deleterious to the particular patient.

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Read before the Eighteenth Annual Convention of the American Physiotherapy Association, Denver, Colorado, June 26, 1939.

Depressed patients require stimulation in all therapeutic measures. Cold sprays and Scotch douches are the most effective means of stimulation. If the depressed patient is agitated, sedative tubs and packs may be indicated. Alternating hot and cold sprays, fomentations, salt glows and massage may be beneficial.

Apathetic, stuporous and catatonic patients of schizophrenia and certain hysterical individuals require stimulative physical therapy. The psychiatrist is attempting to interest the patient in reality through stimulation. Alternating hot and cold sprays, fomentations, Scotch douches, salt glows and massage, in general, are indicated.

Toxic and delirious patients require sedative and eliminative therapy in the form of continuous tubs, warm sprays, fomentations and Scotch douches. "Cold wet or warm wet packs are usually contraindicated chiefly because the restraining element produces fear."[5] The electric light cabinet should not be used in the event of delirium or if the patient is in an intoxicated state.

Many psychiatrists favor colonic irrigations while others oppose this procedure because of the patient's misinterpretation, which may lead to panic. Sexual stimulation may be aroused, inducing anxiety, tension, fear and resulting panic. Colonic irrigations are considered by many medical men to be in disrepute because of misuse by quacks and cultists.

A number of organic reactions of cerebral arteriosclerosis, senility and paresis may respond well to the same type of physical therapy that is used in toxic and delirious states.

Tension states and anxious psychoneurotics, in general, react well to sedative physical therapy in the form of continuous tubs or cold wet packs. Warm needle sprays, fomentations, Scotch douches and salt glows may be beneficial, but the treatment here again is definitely individual.

Sleep disorders of insomnia, that is, difficulty in falling to sleep, broken sleep or early morning waking, respond well either to continuous tubs or cold wet packs administered before retiring—more effectively than to medicinal therapy.

Physical therapy, as a rule, is contraindicated in the treatment of paranoid reactions. The mechanical procedures and apparati are misinterpreted as part of the persecution. Physical therapy is likewise contraindicated in various types of homosexuality because of the danger of unwitting stimulation and panic. When there is a tendency on the part of the patient to become overdependent on physical therapy then the procedure may become contraindicated as in the case of certain psychoneurotics.

Chronic alcoholics may use a physical therapy department as they would a commercial "Turkish bath." Unknowingly, the therapist and the physician may be accessories to the patient's alcoholism by frequently "sobering him up" so that he may continue with his chronic addiction. Thus the patient postpones or avoids fundamental psychiatric care.

It may be well to consider the various physical therapy procedures used in psychiatry. It is important that each be looked upon as a treatment adjunct and not as a restraining method. To avoid this, tubs and packs should be given at regular intervals and not necessarily follow the patient's excited or destructive behavior. Nurses or therapists should announce to the patient beforehand that a tub, pack, spray, et cetera, is to be administered. Frequent supervision by nurses or therapists is essential. In general most patients like the continuous tub best.[6] This may be given as a prescription for a duration of one to twenty-four hours. A frequent method is to prescribe it as hours one and a half, twice daily. In case of extreme excitement this may be increased to hours two or three, three times daily, or continuous. The water has its most beneficial effect at a temperature of 96 F., although in cases of hyperpyrexia temperatures up to 99 F. may be indicated. It is best to have continuous tubs in separate rooms, sound-proof if possible. These rooms may be darkened if the patient is not markedly confused or hallucinatory. The canvas covering may be used if necessary, but naturally it is better to administer the tub without it. The patient may need constant reassurance that the continuous tub is a therapeutic measure. The nurse or therapist should be aware constantly of the dangers of suicidal drowning. There is also the possibility of cardiac collapse or heat stroke, particularly in excited, debilitated patients. If there is any doubt in the minds of the nurses or therapists of these complications, treatment should be terminated immediately. Frequent observation of temperature and pulse recordings is precautionary. The cold wet pack is administered with wet sheets of temperatures of 60-70 F. The

duration of the packs is usually an hour to an hour and a half and may be prescribed once, twice or three times daily. In certain cases cold wet packs are repeated in successive order for the desired therapeutic effect. Warm and dry packs are less desirable. The packs may be used as emergency measures in extremely destructive patients, and they may be of help in the administration of tube feedings. Cold compresses or ice bags are applied to the head when the patient is receiving either a tub or pack. Saline, or salt, ice water (.6 of 1 per cent) should be administered to excited patients as a precautionary measure against heat stroke. It is now well recognized that heat strokes are closely connected with hypochloremia. The best treatment of this condition is hyperventilation with fans and alcohol massage, in contrast to the earlier method of packing these individuals in ice.

"The packs and baths induce certain physiological effects because of their own peculiar properties. In both types of treatment there are warmth and moisture which of course have a definite action upon the vasomotor system. There is a dilation of the superficial vascular bed and a concomitant drainage of the central organs. The water or wet blankets establish a constant temperature with the result that cutaneous stimuli and especially thermal stimuli are greatly reduced.

"When the patient is snugly confined in a pack there is also a reduction in the stimuli which arise in voluntary muscular activity. Every time a muscle contracts or a part of the body moves, there is a series of centripetal nervous impulses and the restraint of the pack therefore tends to decrease cerebral activity. This effect is often counterbalanced at the beginning of the treatment through the necessary manipulations and in the protest against confinement."[6]

Needle sprays and Scotch douches are given as warm applications at temperatures from 110-118 F. and as cold applications at temperatures from 60-70 F. In the treatment of depressed, inactive patients close observation of the pressure of Scotch douches is required. The pressure may range from 30 pounds up depending upon the physician's prescription. One should make note and report to the physician any skin eruptions or pruritis.

Cold sitz baths prescribed for 20 to 30 minutes once or twice daily are helpful in combatting extensive and compulsive masturbation in mental problems.

Salt glows produced by circular rubbing of salt into the skin may be used in conjunction with needle sprays and Scotch douches. This has a definite stimulative value, but probably less so than the hydrotherapy measures.

Electric light cabinet treatments must be applied cautiously. It is my opinion that the common practice of using the electric cabinet for elimination in chronic alcoholism and other toxic conditions is a dangerous procedure. Even in short treatments of 10-15 minutes the patient is likely to run a temperature and develop cerebral edema, aggravating or precipitating a delirious reaction in the patient. The alcoholic already is suffering from cerebral edema and elevated intracranial pressure, and to increase this swelling of the brain and spinal pressure is precarious. We know through research with hyperpyrexia that alcoholics are prone to develop delirious and convulsive reactions if subjected to intense heat.[7] Delirious reactions follow the indiscriminate use of the electric light cabinet in the early stages of therapy. In addition, convulsions may ensue because the heat and rising temperature cause an increased intracranial pressure. Toxic, alcoholic and delirious patients, therefore, should not be given electric light cabinet treatments until at least a week or ten days of more conservative treatment have passed.

Ultraviolet irradiation has a beneficial effect in creating better general muscle tone in debilitated and inactive patients. It creates a feeling of well being and may be a definite adjunctive, stimulating therapy. Whirlpool baths, infra-red lamp treatments and diathermy (except in hyperpyrexia) are of benefit only in the care of physical ailments. The galvanic machines producing a sinusoidal and galvanic current are not indicated in the treatment of psychiatric disorders although they may be beneficial with neurological conditions.

In general, massage is a sedative type of therapy but there are many contraindications to this procedure. The subject has been well covered by Billings and Collins,[8] who feel that great individualization must be exercised. With homosexuals, certain agitated depressions with increased sex urge, paranoid reactions, some hysterical cases and patients overdependent on mechanical procedures this type of physical therapy should not be prescribed.

Modern fever therapy in psychiatry is not new. It dates to the discovery by Wagner von Jauregg[9] in 1917 of the therapeutic value

of malaria fever in the treatment of dementia paralytica, or general paresis (syphilis of the brain). Remarkable results were obtained in these cases through the fever induced by malaria germs. However, certain disadvantages presented themselves because of the superimposed induced infection. In 1929 Neymann and Osborne[10] and in 1930 King and Cocke[11] experimented successfully with artificial fever using the diatherm machine in the treatment of general paresis. Their results were comparable to those obtained by malaria inoculation, but because of the frequent burns and the inability to sustain long temperatures, workers looked for other mechanical devices to raise the patient's temperature. Hinsie and Blalock[12] were pioneer investigators with the ultra-high frequency oscillator, or radiotherm. An evolution of this machine is the modern inductotherm, used extensively throughout clinics in this country. The inventor, Kettering, and his medical co-worker, Simpson,[13] instituted a research program with a new Kettering hypertherm—a hot air-conditioned cabinet. From the early part of 1935 to the present, the fever therapy department at the University of Colorado Hospitals has worked continuously in this national research program. A great deal of research in the field of fever therapy has been accomplished throughout this country and in Europe. In 1937 the First International Conference on Fever Therapy was held in New York and was attended by physicians throughout the world. The most outstanding results have been obtained in the treatment of general paresis and other forms of neurosyphilis, gonorrhea and its complications, and Sydenham's chorea. There are other diseases which appear to respond but sufficient time has not passed to ascertain if these improvements are lasting. Intensive experimental research with other mental disorders has failed to produce satisfactory results with artificial fever.

The common prescription of hyperpyrexia for the treatment of neurosyphilis now consists of a course of 36 hours of continuous temperature of 105-106 F. (R.) This fever is administered in 12 sessions of three-hour heatings given at weekly or bi-weekly intervals. In addition, chemotherapy in the form of tryparsamide, Mapharsen, or bismuth subsalicylate may be administered before each fever session. There are certain advantages for both induced malaria fever and artificial hyperpyrexia. Artificial fever appears to be more practical in that hospitalization is not required as a rule, and the patient may continue with his occupation while he is taking the course of treatments. A comparative study of the relative values of the two methods, malaria and artificial fever, is being carried on at the University of Colorado Psychopathic Hospital. A preliminary report on this subject was published in 1936.[14] To date it is believed the results of the two methods in the treatment of syphilis of the nervous system are comparable.

Sydenham's chorea, or St. Vitus' dance, responds excellently to artificial fever therapy.[15] Attention was first drawn to hyperpyrexia by Sutton who successfully treated hundreds of children with induced fever-producing typhoid vaccine. Mechanical artificial fever appears to have advantages over Sutton's method, and as a rule is less dangerous. The course of treatment usually consists of daily or less frequent fever sessions of two or three hours until a recovery is sustained. The average case requires 12 or 13 treatments and usually is under treatment and observation approximately three weeks. It appears that fever therapy has a definite place in the armamenture of medical science.

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The
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During the past ten years the American Physiotherapy Association has devoted much time, energy and thought in raising standards of education. We can well be proud of the results of this labor and look with satisfaction upon the number of schools which have adopted these high standards. This should be just a beginning for us. It was brought out at the Eighteenth Annual Convention that this is not enough—that we must continue to raise our own personal standards of education.

The students graduating today must continue to study and learn as they advance in their profession in order that they may adequately fulfil the responsibilities that rest upon them. The graduates of five, ten or fifteen years ago must avail themselves of every opportunity to refresh their minds and keep themselves up to the standards of today. It has been found that we may be lacking in knowledge of one part of our work; for example, the crippled children's program. This field, which has grown so rapidly, may find itself stranded through lack of technicians sufficiently trained in that phase of the work to give adequate service to the community and to the child.

We urge all members to make it their personal responsibility that they keep abreast of the times through current literature and through lecture courses given by chapters. We urge that the schools on the approved list of the American Medical Association offer summer and evening courses in order that we may have the opportunity to meet more adequately the growing needs of our profession. If there is demand by members, the schools, we are sure, will endeavor to meet this need.

The Review is trying to do its part by bringing to you the best of material available on physical therapy, a complete index to current literature, book reviews and abstracts of current literature. It is only by each of us meeting these increased demands that we can truly raise the educational standards of the American Physiotherapy Association.

Doctor R. C. Hood in his address at the recent convention said: "I appeal to you, therefore, to continue the fine work that you have been doing in the maintenance of standards for your profession. I urge you to extend your efforts in the field of research and review of end results, and ask that you promote the development of a more adequate field service that will make your work more effective in giving the child his best chance for ultimate recovery and for enjoyment of a satisfactory life." This applies not only to the child but to every patient we treat. Let us each accept this challenge and make it our personal responsibility to maintain and advance our own standards of education.

Notices of Meetings

The Eighteenth Annual Scientific Session of the American Congress of Physical Therapy was held at the Hotel Pennsylvania in New York City, September 5 to 8, 1939.

The Panamerican Congress of Crippled Children will be held in San Jose, Costa Rica, October 12 to 19, 1939.

The Annual Congress of the Chartered Society of Massage and Medical Gymnastics will be held in London, September 18 to 22, 1939.

Chicago Chapter

Lucy Bonner Cooper, a member of the Chicago Chapter, who had been employed at the Lutheran Deaconess and Francis Willard hospitals in Chicago, died on July 18, 1939.

A daughter, Claire Louise, was born on August 10, 1939, to Mr. and Mrs. Walter Chase. Mrs. Chase is the former Louise Adams.

There is a possibility of an exchange position in the Melbourne Children's Hospital, Australia. Any members interested in a project of this sort should contact Mrs. Eloise T. Landis, Secretary of the American Physiotherapy Association, 2065 Adelbert Road, Cleveland, Ohio, as soon as possible.

Correction

In the July-August 1939 issue, page 217, under West Michigan chapter report, there is mentioned a movie on "Infantile Paralysis" taken by Dr. J. T. Jerome at the University of Chicago Medical School. The report should have included that this movie was arranged by Dr. Edward L. Compere and Dr. Paul Harmon of Chicago.

Ethel Chapman, a member-at-large, who was employed at Monmouth Memorial Hospital, Long Branch, New Jersey, died in June 1939, after an illness of three weeks' duration.

In the Thirty-Ninth Annual Presentation of Educational Data by the Council on Medical Education and Hospitals of the American Medical Association[1] under "Essentials of Approved Residencies and Fellowships" is included the following: *"Physical Therapy*—The department should be under the direction of a physician qualified by training and experience in physical therapy. He should spend sufficient time in the department daily to supervise actually the work of the graduate students and technicians. Adequate space and apparatus should be furnished in the department for all phases of the work. The clinical material should be sufficient in kind and amount to enable the residents and fellows to observe and study all forms of treatment in physical therapy. Both inpatient and outpatient clinical material should be available.

"A minimum of three years of special training is considered necessary for a physician to qualify as a specialist in physical therapy."

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Rehabilitation of the Chronically Disabled with Special Reference to the Use of Physical Measures. FRANK H. KRUSEN, M.D. Military Surg., April 1939.

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ABSTRACTS

John S. Coulter, M. D.

Physiotherapy in the Common Cold and Sinusitis

W. Kerr Russell, M.D. In Brit. J. Phys. Med., April 1939.

Treatment can be prophylactic or curative and at the present time the former is probably the more important.

Exercise and fresh air: Adequate exercise out of doors is very important especially if associated with deep breathing. During the Great War, despite the hardships and exposure to wet and cold, there was a remarkable freedom from catarrhal conditions.

Baths: Cold baths are valuable for those who experience a healthy skin glow immediately afterwards; they are not suitable, however, for those who do not react in this way and who tend to become cold, cyanosed and shivery.

Clothing: Suitable clothing is another important factor. Over-clothing should be carefully avoided and a mesh type of under-clothing should be worn. The clothes, in fact, should be light, loose and porous.

Diet: A correct diet is of great importance and should contain adequate amounts of protective foodstuffs including vitamin A which, by helping to maintain the integrity of the epithelial lining of the air passages, has an anti-infective value. This vitamin is present in milk, butter and eggs and also in cod liver and halibut liver oils.

Ultraviolet irradiation: The prophylactic value of general ultraviolet irradiation is not universally realized. Natural sun baths in the open air or exposure to a lamp emitting ultraviolet, visible and infra-red rays will produce the required effect.

Experimental work at Bournville: Much work on the prophylactic effect of ultraviolet irradiation has been done but probably the most recent is that by J. B. Sherman, the medical officer at Bournville Works; this work is described in the British Medical Journal of October 29, 1938.

Sherman points out that two results could be expected, namely (a) a reduction in the number of colds contracted; and (b) a diminution in the severity of the colds.

Both these factors would affect the loss in working days per employee. The number of working days lost in the previous winter of 1936-37, before the commencement of the experiment, was 2.12 for the controls and 2.25 for those receiving treatment. The author found that the number of working days lost per person was substantially reduced with ultraviolet irradiation and slightly reduced by vitamin treatment. It was an interesting fact that, though certain of the benefits resulting from ultraviolet irradiation are known to be due to the formation of vitamin D, the irradiation results were much better than those obtained from the oral administration of vitamin D, proving that ultraviolet irradiation produces other effects in the body.

The author summarizes his results as follows: "It was found that the only method of real value was ultraviolet irradiation, which reduced both the severity and the number of colds in patients so treated. The method is cheap and easily applicable to large numbers of employees. Its use by big industrial concerns would definitely lower the tremendous economic losses at present caused by the common cold."

The Treatment of Fractures of the Patella

Albert Key, M.D. In Am. J. Surg., April 1939.

Treatment of Simple Fractures in Which the Fragments Are Not Separated

In fractures in which it has been decided not to operate it is advisable to aspirate the knee joint and apply a pressure dressing for from twenty-four to forty-eight hours, having the patient remain in bed either with or without a posterior splint.

After the excess blood in the joint has been removed, a plaster of Paris cast is applied with the knee in a position of extension.

At the end of from four to eight weeks, de-

pending on the fracture and the age of the patient, the plaster cast is removed and the patient may begin to bend the knee. It will be found that a relatively small amount of movement will be permitted. However, the knee should not be forced. The patient may apply hot wet compresses or dry heat to the knee two or three times daily and should exercise the quadriceps and begin to walk. At first crutches are used and then a cane; as the power in the leg returns the support is abandoned. For at least four weeks after the removal of the cast the patient is cautioned not to put his weight on the leg with the knee in a position of flexion but to walk with the knee straight, because not only is the union not firm, but extensive atrophy has occurred in the patella and it can be refractured with relatively slight force.

The Management of Postural Deformities of the Lower Extremities

Ernest E. Myers, M.D., New York City. In Am. J. Surg., April 1939.

Speaking of the foot, Sir Arthur Keith says, "Attention must first be directed to its prime movers, its muscles—Nature never uses ligaments as prime supporters in the structure of the animal body . . . ligaments serve only as safeguards." Steindler agrees that "in the maintenance of the normal configuration of the foot the muscles stand in the first line of defense."

Dudley Morton, Lake, and Wiles, however, believe that the muscles merely assist in maintaining balance, and that weight is distributed throughout the foot from bone to bone much as it is transmitted from femur to tibia.

Treatment: Fundamentally, the aim of treatment is to restore correct weight-bearing alignment of the foot with the leg to assure transmission of weight both in standing and in motion so that the tripod-like weight distribution in the foot receives its proper proportion at each of the three main supporting points.

Exercise, the most important step in conservative treatment of postural deformities of the foot, ironically is the most difficult, because it is not easy to get and keep the patient's cooperation. Handing him a printed explanation of exercises is wasting paper; he must not only be convinced of their value but also made enthusiastic about persevering at them.

The chief disadvantage of exercises and exercising devices is that a certain hour must be set aside for them, usually in the evening. There is much doubt in my mind that ten minutes of even conscientious exercise at the end of a fatiguing day can counteract the breaking down effect of eight hours or more pounding hard, unyielding city pavements or floors. Therefore, I depend upon one exercise which can be done in the shoes six or eight times daily, never for more than sixty seconds at a time, and at odd moments such as while shaving, brushing the teeth, or standing in subways. Its main value is that it can be repeated frequently and without loss of time. One merely has to think of it to do it. The exercise consists of standing in a slightly forward-leaning position to increase the weight on the forefoot. The toes are firmly plantar-flexed pushing up the midfoot like a cat's arched back, and rolling the foot slightly to its outer border. All this must be done with real effort, as if actually lifting the body weight. The tendency for the head of the first metatarsal to leave the ground must be firmly resisted. This exertion calls into action the peroneus longus. The contraction of the toes employs the long and short toe-flexors, and the moderate inversion motion makes the tibialis posticus work. Contracting the gluteii maximii (pulling the cheeks of the buttocks together) while thus curling the toes tends to correct the internal rotation of the leg which accompanies foot pronation, and it helps to bring the leg and foot into equilibrium more quickly. The value of this exercise (gluteal contraction) was emphasized by Lowmann in 1912, has been reiterated from time to time by subsequent authors, and has been periodically forgotten by the majority.

If heel cords are short, that is, if they do not permit dorsiflexion of the supinated foot to the right angle, they should and can be stretched. This can be done manually or by the following method. The patient faces the wall an arm's length away, standing on the outside of his feet without shoes—toes curled under, heels on the floor. Keeping the body stiff, he lets it fall toward the wall by bending the elbows. The feet must be kept supinated in order to avoid straining the inner borders. If this performance is properly done, real strain is felt behind the knees and in the calves. Some authors deny that the tendon Achilles can be stretched. Thoroughness and perseverance in the fashion here recommended will prove them wrong. The rare case,

so severe and persistent that stretching will not cure it, can be so much helped by lengthening that operative correction is worthwhile.

Treatment of Gastrointestinal Tuberculosis

Leo L. Hardt, M. D., Morris Weissman, M. D., John S. Coulter, M. D., and Karl J. Henrichsen, M. D., Chicago. In J. A. M. A., 112:8:691, February 25, 1939.

This study comprises a group of patients known to have active, far advanced pulmonary tuberculosis complicated by intestinal tuberculosis.

In evaluating the various types of medical treatment suggested for the cure of intestinal tuberculosis it is necessary to assume that the patients under observation are suffering from active intestinal tuberculosis. It is not our aim in this paper to discuss in detail the methods used in arriving at a clinical diagnosis; they will be submitted for publication at a later date. These methods of diagnosis were followed in approximately 553 cases over a period of five years. Fifty-five patients came to autopsy, and of these diagnosis was correct for 86.4 per cent.

From the many authors that could be cited concerning the efficacy of calcium therapy one would be led to believe that the two general factors involved are (1) the pharmacologic action of calcium and (2) the replacement of the calcium lost through the dehydrating action of the diseased intestinal tract, together with mineral loss through the sweat glands.

Although the diet outlined by us is adequate in calcium for the normal person, it may prove deficient because of the extra losses of calcium from the tissues through the bowel and sweat glands. The good results obtained with calcium therapy may be due largely to the replacement of calcium in the tissues, together with the pharmacologic action of calcium.

Conclusions

Calcium given by mouth, intravenously or intramuscularly appears to have definite therapeutic value in the treatment of intestinal tuberculosis. One method of administration has no particular preference over another.

Ultraviolet irradiation plus calcium therapy seems to have a slightly more beneficial effect than calcium therapy without irradiation.

A high vitamin, smooth, high mineral diet is not as effective alone as with either ultraviolet irradiation or calcium therapy or as ultraviolet irradiation with calcium therapy.

Collapse therapy is an aid in the treatment of gastro-intestinal tuberculosis, probably through the improvement in the pulmonary condition and the resulting decrease in the number of bacilli in the sputum.

Cleansing the mouth by chewing paraffin and expectorating for one-half to three-quarters of an hour after clearing the lungs by coughing is a practical measure in the prevention of intestinal tuberculosis as well as in its active treatment.

Acute Arterial Occlusion of the Extremities

W. Emory Burnett, M.D., F.A.C.S. In Am. J. Surg., April 1939.

From a limited experience and a study of the literature it appears that the best results are derived from (1) early diagnosis before ischemia produces irreparable harm; (2) abolition of spasm; (3) extraction of the clot or arteriectomy; (4) passive vascular exercise for increasing collateral circulation; and (5) protection of devitalized tissue from immoderate heat and from further deprivation of blood by elevation.

Passive Vascular Exercise. This has been reintroduced and modernized by Hermann and Reid and Landis and Gibon. It produces definite improvement in most cases of such inadequate circulation and frequently prevents gangrene. If immediate treatment by antispasmodics and/or embolectomy is not successful, or if the patient is seen too late for their use, the pavaex treatment of alternate negative and positive pressure is definitely indicated and extremely beneficial. Hermann and Reid advise slow oscillation of from 40 mm. of mercury positive to 80 mm. of negative pressure with four cycles per minute, five of each fifteen seconds of a cycle for the positive and ten seconds for the negative phase. An additional substratum of short oscillation occurring eighty to one hundred times per minute throughout both phases is included in the apparatus designed by Hermann. The treatments are from one-half to two hours and should be given several times a day. According to these authors "there seems to be no limit to the time the treatment can be carried out without discomfort or untoward effects."

Orthopedic Considerations in the Treatment of Arthritis

William T. Green, M.D., Boston, Massachusetts. In Am. J. Surg., April 1939.

Physical therapy. The measures during the acute phase are directed toward the maintenance of motion, combating atrophy in the muscles which are antagonistic to the deformity, and relieving pain. Heat is helpful in allaying discomfort and as a preliminary measure to the exercises. Radiant heat may be used, although moist heat frequently is more soothing in very painful joints. The latter may be given either with wet towels heated with a lamp for radiant heat, or by placing the patient in a warm bath such as the Hubbard tub. Prolonged heat is to be avoided.

If the Hubbard tub is used, exercises in water are given, always guided and active in type and directed toward decreasing the deformity. The temperature of the water is ordinarily from 98 to 100 F. It may be a little warmer, although never over 104 F., if the joints are very sensitive; or of lower temperature if the period in the water is to be quite prolonged. The buoying effect of the water is of great assistance, but too long a period in warm water is enervating and must be avoided. The movement of the joints always must be active or guided active, never passive. Passive motion increases spasm and pain and does not allow as great a range of movement as do guided active maneuvers. The maximum arc of motion that may be obtained without undue discomfort should be secured each day. Ideally the range should be that which can be obtained painlessly, but a certain amount of discomfort is inevitable in most instances if function is to be preserved.

The exercises need not be done in water. If not, they should be carried out by a technician who supports and guides the part through its arc of active motion, assisting in the extremes as sensitivity permits. At first, if the joints are very sensitive, only three or four motions of each joint should be performed, but the exercises should involve all the possible directions of motion at the particular joint, always emphasizing motion opposite to deformity.

"Muscle setting" exercises are very useful in combating atrophy in muscles. They can be done by the patient without assistance and are not painful. Since in "setting," the muscle is contracted with its origin and insertion closely approximated, the stimulating effect of the exercise is greater than would otherwise be the case. These exercises are particularly helpful in the instances of the quadriceps and gluteus maximus.

Massage after the application of heat is a usual measure in conjunction with exercises and should be directed toward the atrophic muscles. Direct massage over sensitive joints is contraindicated.

If it is suspected that the exercises are too strenuous and are increasing sensitivity, they may be temporarily diminished in amount to determine whether they are an irritating factor. There are certain days when the joints are more painful than others, and activity on these days should be less. However, a certain amount of movement must be carried out, and rarely should a day pass without some motion. An accurate record should be kept of the arc of motion existing in the various joints and particular effort should be expended in maintaining it.

The correction of deformities and care during the very active phases are performed best in an institution. Once progress is being made and deformities are corrected, it is frequently possible to carry on at home. Some one in the household usually can be taught by the physical therapist to guide the exercises twice a day. However, these must be checked at regular intervals by the clinician and the physical therapist. The patient can carry out some of the exercises himself, but many require help and supervision. Ideally a trained physical therapist should supervise the exercises at all times, but in practice, they must be done in such an amount that some one living with the patient should be able to assist with them. Immobilization is practiced at home as indicated as long as there is activity.

As the process becomes quiescent, exercises become more strenuous. Synovial thickening, sensitivity, and the general clinical picture, as well as laboratory determinations, are indices of activity. Walking must be attained gradually, and not before the muscles are strong enough to carry out their function. A therapeutic pool is of assistance when walking is started. Various supports may be necessary, such as caliper braces and crutches. Care should be given in the choice of shoes and frequently the feet must be protected by steel plates or flexible pads made in the form of an insole with the supporting factor either of felt or of sponge rubber. If deformity has not developed and motion has been preserved, the problem of rehabilitation may be relatively simple. Progress must be slow.

Play Therapy—A New Science

Ethel Kawin. In Modern Hospital, 52:4:44, April 1939.

Illness subjects children to many trying experiences, even in the best regulated hospitals. Fears of operations, feelings of insecurity in an unfamiliar situation, home sickness, disturbing pain, lonesomeness, restlessness, boredom, these and other disintegrative reactions that almost inevitably arise in the hospitalized child can be treated effectively or even averted entirely by wise play "therapy."

The child who is engrossed in play is not likely to grow resentful against people and conditions, has little time to worry or to feel sorry for himself and is not likely to become habituated to invalidism. He maintains stimulating interests and retains cooperative contacts with other children. Even a long period of hospitalization under such conditions need not leave psychologic scars which handicap him in his later efforts to return to patterns of normal living.

Although a few hospitals have pioneered with excellent play programs as integral parts of their care of children, it is somewhat startling to discover the extent to which most hospitals—even those with otherwise excellent standards of care—tend to ignore the psychologic, social and play needs of little patients.

The average nurse has neither the time to serve nor the training to understand the social and play needs of children, and many hospitals at present do not feel able to employ specialists who are equipped to give this service.

The amount of play permitted must be determined, of course, by the physician. The child should not be strained by too much excitement or fatigue.

Artificial Respiration: Its Importance in Hospital Emergency Practice

Wills Maclachlan, B. A. Sc., Toronto. In Canadian Hospital, 16:5:17, May 1939.

Apparent Drowning

Quickly remove victim from water and place on ground or other hard surface.

Gas Asphyxiation

The first thing to do is quickly to get the patient into fresh air.

Fresh air does not mean out of doors in cold weather.

Do not breathe gas yourself, even for a short time. If it does not overcome you, it will cut down your strength.

Electrical Shock

The victim must be freed from the contact as promptly as possible. Use a dry stock, dry rope, dry coat or other non-conductor.

The use of your own hands without protection is dangerous and may add another victim to the accident.

Artificial Respiration

Follow these instructions even if victim appears to be dead.

As soon as possible feel with your fingers in the patient's mouth and throat and remove any foreign body (tobacco, false teeth, etc.). If the mouth is tight shut, pay no more attention to it until later. Do not stop to loosen the patient's clothing, but immediately begin actual resuscitation. Every moment of delay is serious. Proceed as follows:

(1) Lay the patient on his stomach, one arm extended directly overhead, the other arm bent at elbow and with the face turned outward and resting on hand and forearm, so that the nose and mouth are free for breathing.

(2) Kneel, straddling the patient's thighs with your knees placed a short distance from the hip bones.

Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position and the tips of the fingers just out of sight.

(3) With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. Do not bend your elbows. This operation should take about two seconds.

(4) Now immediately swing backward so as to completely remove the pressure.

(5) After two seconds swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release, a complete respiration in four or five seconds.

(6) Continue artificial respiration without interruption until natural breathing is restored; if necessary, four hours or longer, or until a physician declares the patient is dead.

(7) As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight

clothing about the patient's neck, chest or waist. Keep the patient warm. Do not give any liquids whatever by mouth until the patient is fully conscious.

(8) Avoid strain on the heart when the patient revives; he should be kept lying down and not allowed to stand or sit up. If the physician has not arrived by the time the patient has revived, he should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a glass of water or a hot drink of coffee or tea. The patient should be kept warm.

(9) Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. He should not be moved from this point until he is breathing normally of his own volition and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, or such, to move the patient before he is breathing normally, resuscitation should be carried on during the time that he is being moved.

(10) A brief return of natural respiration is not a certain indication for stopping resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and, if natural breathing stops, artificial repiration should be resumed at once.

(11) In carrying out resuscitation, it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. By this procedure no confusion results at the time of change of operators and a regular rhythm is kept up.

The ordinary and general tests for death should not be accepted and the physician or intern should make several very careful and final examinations and be sure specific evidence is present before pronouncing the patient dead.

As has been stated above, the simple instruction of people in artificial respiration has not been sufficient to produce well trained persons at an actual case where resuscitation is required. The method of training used is as follows:

After an explanation of the method, the people to be trained are arranged in pairs—one acting as the patient and the other as the operator. The instructor carefully checks each operator to be sure that he is carrying out the artificial respiration correctly and after five minutes of artificial respiration, the operator becomes the patient and the patient the operator and the procedure is again carried through. It is wise to have those persons who should be trained and ready for an emergency to regularly practice artificial respiration. In public utilities, this practice is carried out at least once a month and it is only by this means that prompt and efficient application of artificial respiration has been obtained. As it is necessary at times to carry out artificial respiration over a considerable period, employees are also trained in a simple and effective method of changing from one operator to the next.

Briefly stated the most salient points in artificial respiration are the following:

1. Clear the victim as quickly as possible.
2. Apply artificial respiration with as little delay as is possible. Do not waste time trying to move the patient to some more convenient spot.
3. Use warmth, such as blankets, hot water bottles, et cetera.
4. Carry out artificial respiration until the patient breathes or there are definite signs of the onset of rigor mortis.
5. Transport the patient in a lying-down position to his home or hospital. Put him to bed and treat as for surgical shock.

A New Method of Joint Measurement and a Review of the Literature

Frank J. Wiechec, B.S., and Frank H. Krusen, M.D., Rochester, Minn. In Am. J. Surg., XLIII: 3:659, March 1939.

It is the purpose of this paper to introduce a system of measurement which it is hoped will simplify and standardize methods of measuring joint motion, since there seems to be some confusion and disagreement among physicians and physical therapy technicians regarding terminology, methods and instruments for measuring and recording joint motion.

A Simplified Instrument for Joint Measurement

An instrument has been devised at the clinic by which any joint in the body can be measured. With only a moderate amount of care in placing it and in taking the reading, as great accuracy is attained as with a much more complicated apparatus. This instrument consists essentially of a stand which is joined to a higher upright. A protractor scale is attached to this upright in such a manner that it can be moved upward and downward in the vertical plane; or the stand can be detached

and the protractor can be used in the horizontal plane. Also attached to the upright are two long arms. These move along the scale and facilitate movement and reading of joint motion. The reading is taken by placing the instrument so that its little axis pin is over one end of the axis of motion of the joint under observation, the upper arm corresponding as nearly as possible to the long axis of the bone above the joint and the other arm being in the same relationship to the bone or bones below; the upper arm of the instrument is held firmly in position either by hand or by straps, while the lower bone member of the joint is moved in one direction to its fullest extent. The reading is then taken on the scale. Following this, motion is made in the opposite direction and the reading is taken again. Thus there is determined the number of degrees of motion allowed and the relationship of the extreme positions to the axis of the proximal bone.

There is definite need for a systematic and uniform method of measuring and recording joint motion, which is clearly shown by records in medicolegal cases, of industrial compensation boards and by statements of physicians.

As a result of recording measurements, there is a markedly beneficial psychologic effect when the patient can follow his progress graphically. Accurate measurements, however, necessitate a uniform system of measuring joint motion. Various current systems are discussed and instruments used for measuring joint motion are illustrated.

The lack of uniformity in records, the great number of instruments used for measurement and the diversity of terms used in describing motion have caused much confusion. A system of measurement is therefore presented which defines the movements of nearly all the joints of the body, and an instrument that will measure joint motion accurately is described. Approximate normal ranges of motion for the joints discussed also are given. This system is based on the following: Measurements of movements made toward the head in the anteroposterior planes will read toward 0 degrees; measurements of movements away from the head will read toward 180 degrees. In the lateral plane, measurements of movement toward the body will read toward 0 degrees and measurement of motion away from the body will read toward 180 degrees. All measurements will be made on the half circle scale from 0 to 180 degrees.

Physical Measures in the Treatment of Neurologic Conditions

Richard Kovacs, M. D., New York City. In N. Y. State J. Med., 39:9:917, May 1939.

In polyneuritis of a rheumatic or toxic type general heat measures—electric cabinet baths, hot baths—are indicated for stimulation of metabolism and increased "elimination." Artificial fever therapy, the rationale of which will be discussed later on, is justified in severe or resistant types and recently has been favorably reported upon by clinicians.

In localized neuritis caused by trauma or pressure, physical measures should be instituted from the outset while a search for the exciting cause is carried on. Rest and relaxation of the affected area by bed rest, light splinting, or a sling are simple and effective measures. It is indeed quite a question whether in acute neuritis with very severe pain, the relief obtained by any form of office treatment is worth the effort and risk of going about to procure it.

Bell's palsy due to neuritis of the facial nerve is of special interest because of the favorable possibilities of early treatment by physical means. It has been shown that edema in a nerve trunk may interrupt the passage of nerve impulses along the axons, especially if the edema happens to be at a point at which the nerve is passing through a bony canal. The effect of exposure of the facial nerve brings on edema that blocks the facial canal near the point of exit and presses on the facial nerve. This etiology offers the possibility of a quick absorption of the edema by suitable physical measures, as has been amply proved by clinical experience of the author and that of other clinicians. It also explains the number of spontaneous recoveries within a few days or weeks, with absence of the reaction of degeneration in the so-called light cases. On the other hand, in untreated or originally severe cases, secondary involvement of the nerve fibers occurs due to continued pressure and, according to the extent of the nerve degeneration, a condition lasting from a few weeks to a year and leading possibly to permanent atrophy of some of the smaller muscles may ensue. On the basis of these facts, the immediate application of "decongestive" measures in cases of Bell's palsy seems rational and the usually quick and uncomplicated recovery of cases treated from the onset makes it evident that the former dictum, that no treatment and especially "no electricity"

should be administered during the early period, is obsolete.

Treatment should begin in all cases with a superficial thermal measure such as the radiation from a small luminous heat or infra-red generator. An exposure of from twenty minutes to one-half hour also serves to relieve pain if present. The comfort given by diathermy or short-wave diathermy is even more marked. The measure of choice for "decongestion" is the static-wave current.

In trifacial neuralgia physical treament as a rule is not very satisfactory.

Among physical measures indicated in nerve injuries the intelligent use of splinting is one of the most important ones. It is regrettable to see, every so often, a person with a drop foot or drop wrist referred for electrotherapy in whom no splinting of any sort has been employed. Even the most painstaking form of electrical exercise applied for a short period daily cannot possibly overcome the potential harm caused by continuous drag of the antagonists when proper splinting is neglected. On the other hand, splinting should not be kept up indefinitely, as prolonged immobilization in itself will cause periarticular joint changes and muscle atrophy. Many patients have been incapacitated by the fibrosis that has resulted from the prolonged and uninterrupted use of splints.

Other physical measures indicated are as follows: "massage to improve the nutrition of the parts, to prevent adhesions of scars and fibrosis and to conserve the bulk of muscles; passive movements to prevent deformity from shortening, interphalangeal fibrosis, ankylosis of joints; active exercise to conserve the unparalyzed muscles, to stimulate circulation, to educate synergistic muscles to assume the function of paralyzed muscles; electrotherapy to conserve the vitality, prevent complete atonia and increase the contractility of paralyzed muscles, and hydrotherapy and thermotherapy to assist in nutritional conservation and to facilitate other methods of treatment."

Postural Defects in Elementary School Children

Guy A. Caldwell, M. D., New Orleans. In New Orleans Med. and Surg. J., 91:11:601, May 1939.

As a result of the postural survey the following report and recommendations were made to the directors, parents and teachers:

1. A brief outline of the character and extent of postural deviations was presented to the board of directors and teachers and subsequently at a mass meeting of all parents.

2. A part-time instructress in corrective physical education was employed and charged with responsibility for: (A) Assisting the grade teachers in a corrective program by demonstrating in the room and on the playground the games and exercises adapted to their respective groups; (B) giving special corrective work to groups formed from class "D" throughout the school; (C) through talks, pictures, games and dances, awakening interest in the children in maintaining good posture; (D) aiding the teachers in adapting desks and seats as far as possible to meet the postural needs of the individual child.

3. Following the presentation of the whole problem to parents, a report of the child's postural status and needs was sent to each with directions for getting proper shoes and socks and general advice concerning the dietary needs. In many instances personal conferences with the pediatrician concerning dietary management were advised.

4. Each grade teacher was given a list of the C and D groups in her room with suggestions for better seating, additional rest periods for some and for active exercises or play exercises as outlined by the instructress in corrective physical education.

5. The dietitian was advised to establish a training table for the overweight group but to permit the underweight group to eat with the normal group, giving both a generous diet.

6. The Executive Committee was shown the evils of poor desks and seats and recommendations made for the purchase of adjustable types that would correspond with the principles laid down by Lovett.

Conclusions

1. Static and postural deviations are exceedingly prevalent among pupils in the elementary school years. They are just as frequent in the primary grades as in the more advanced, indicating the need for beginning consistent and intensive corrective physical exercises with the youngest school children.

2. Pronated ankles and knock-knees are present in such a high percentage of primary grade children as to indicate the need of a broad program of education for physicians and parents relative to the advantages of correcting such defects during preschool years.

3. The correction of postural defects during elementary school years must be closely

correlated with improvement of the dietary habits and nutritional status of the children during this rapidly growing period of their lives. The solution of this problem calls for the education of parents and teachers concerning child guidance in selecting and eating proper foods.

4. Better development of the chest by appropriate exercises during the first four years of school life should be possible and would contribute greatly to better body mechanics in later years.

5. The situation in most elementary schools in this city and state is probably the same as has been outlined from the Southfield school survey. The correction of the trouble demands a program of education of parents and teachers as well as revision of the studies and play activities of all the children. To accomplish all this, physicians generally must be convinced of the value of and necessity for such steps, and they must, in turn, pass this conviction on to their patients who are parents.

An Improved Method of Applying Moist Heat to Infected Extremities

J. R. Cochran Jr., M. D., Chicago. In J. A. M. A., 112:20:2039, May 20, 1939.

After several trials the following method was adopted:

The extremity is first covered with petrolatum or preferably with the antiseptic oil used in the nursery. This serves to prevent excess damage of tissue and to hinder the seeding of infection to adjacent hair follicles. The extremity is then wrapped completely around twice with double thickness hot foment blankets. Into the more superior portion of the blankets are incorporated two rubber tubes perforated at intervals of about 1 inch. These tubes are connected to a 2 foot tube by a Y connection, and the single tube is attached to a funnel strapped to the light cradle. The extremity is arranged so that the proximal part of the tube is higher. The spacing of the perforations and the inclination of the tube serve to distribute the water evenly throughout the foment. Two thicknesses of oiled silk are then wrapped round the blanket and the edges turned on themselves and clipped with large spring paper clips. The ends are carefully folded in to make it water-tight. By means of careful wrapping, the bed can be kept dry and comfortable all day. A light cradle is then put over the extremity and covered with a blanket to insulate it against loss of heat.

Temperature recordings taken in more than twenty cases indicate that it is possible to maintain a temperature slightly over 100 F. over long periods of time with one 60-watt bulb. With two 60-watt bulbs temperatures went as high as 112 F. It is inadvisable to use more than 100 watts of energy for fear of burning the patient.

In practice the majority of patients are allowed to moisten their own fomentations as they see fit. Otherwise the nurses pour between 30 to 50 cc. of water into the funnel every hour. The foments are changed only as desired for inspection of the infected area. The extremity therefore is immobilized for long periods.

The Menopause and Painful Stiffening of the Shoulder

Walter W. Voight, M. D., Chicago. In Illinois Med. J., 75:4:340, April 1939.

The treatment of the condition depends upon whether it is present in an acute, subacute or chronic form. In the acute form the predominant manifestations are pain and muscle contracture; in the subacute form, adhesions and muscular contraction, and in the chronic, in addition to adhesions, atrophy of the deltoid and the articular capsule. Immobilization of the arm is important especially in the early cases, and for this purpose the arm sling should be rejected and an abduction splint used instead, retaining the arm at the same time in a position midway between lateral and medial rotation, thereby maintaining equal relaxation of both lateral and medial rotators of the arm. Abduction should not be carried up too far, thus avoiding impingement of the tuberculum majus and its muscle attachments upon the acromion process.

Chronic periarthritis is the result of cicatricial adhesions and muscular atrophy. For this condition forceful stretching under general or local anesthesia has been recommended. In the author's cases such measures were not needed and it is felt that such a procedure may do further injury with hematoma production and repetition of the original process and its sequelae of adhesions and atrophy. Payr used injections of pepsin-Pregl solutions into the connective tissue spaces for the purpose of loosening the cicatricial adhesions, a treatment whose rationale is obvious. The author

has not used this method but has brought his cases to recovery by iontophoresis with histidine salve and massage with the additional use, in appropriate cases, of the abduction splint. To these methods the author adds injections of large doses of progynon, thus giving battle to the *causa morbi* as well as to the local condition. The local methods were extended to the spaces under the deltoid and subscapularis.

All of the author's patients returned to normal mobility again, with the exception of one instance of retraction of the articular capsule where the patient was unable to bring to bear the requisite patience in carrying out treatment.

Resume

1. The disease picture of menopausal periarthritis humeroscapularis is indicated.
2. The condition described apparently consist of an allergy of the menopausal state.
3. In periarthritis humeroscapularis the shoulder joint itself is not involved.
4. Recovery under large doses of progynon and local histidine-iontophoresis.

Therapeutic Physical Measures

K. G. Hansson, M. D., New York. In Bul. Am. Coll. Surg., June 1939.

Physical Therapeutic Measures. Recognized measures include: (1) *thermotherapy* or application of heat from various types of generators for both local and general application; (2) *phototherapy*—includes ultraviolet radiation with carbon arc and quartz-mercury lamps; (3) *hydrotherapy*—includes use of water in various physical states and temperatures with or without chemicals and pressure; (4) *electrotherapy* for thermic, chemical or mechanical action on the body; (5) *massage*—just as important as formerly; (6) *therapeutic exercises* such as underwater, corrective, postural, muscle reeducation and training of spastics. Such new treatments as pressure-suction therapy, iontophoresis and fever therapy can be included in this classification; they have proved their value when properly applied and when indicated by the pathology present. These measures are all endorsed by the Council on Physical Therapy of the American Medical Association.

Fever Treatment. Raising a patient's temperature by physical means is a valuable therapeutic measure but is not without danger, which is increased by inadequate equipment, poor supervision, and lack of experience. The Council has therefore recommended: (1) that fever treatments be given in hospitals only; (2) experienced, efficient staff and nurse-technicians specially trained in fever therapy, in constant attendance and a physician on call; (3) patient should have as thorough a physical examination as if he was to undergo a major operation; (4) treatment under one physician's supervision—division of responsibility has caused several fatalities; (5) essentials in equipment are: (a) some method of inducing internal heat, usually a short wave machine; (b) a cabinet where patient is kept surrounded by an atmosphere of high temperature and high humidity, and (c) some means of automatic registration of rectal temperature such as a thermocouple or a potentiometer.

Essentials of a Physical Therapy Department. The most important factor is the technical staff. In larger hospitals a physician should be in charge and he should have postgraduate training in physical therapy. In smaller ones an experienced technician may be in charge who deals directly with referring physicians. Equipment should meet the hospital's needs and should be controlled by the technical staff. Emphasis should be on the properly trained technician rather than expensive equipment. I believe it is only a question of time when the American College of Surgeons will require that an efficient physical therapy service should be available for every approved hospital. The recommendations of the *Manual of Hospital Standardization* should be followed in the organization of the department.

Treatment of Erysipelas with Ultraviolet Energy

Radiology, Syracuse, N. Y., Feb. 1939. Abstract in J. A. M. A., 112:19:1998, May 13, 1939.

Knapp combines the reports of Titus and Jenkins (who treated eighty-one and fifty cases, respectively) with that of his own (510 cases) on the efficacy of ultraviolet radiation in the treatment of erysipelas. Experience shows that the dosage should be heavy so that the original dose suggested by Ude (twice the erythema dose) has now been increased to from ten to twenty times the erythema dose. A border of 3 or 4 inches of normal skin around the involved area is included in the treatment. If multiple exposures

are necessary, the edges are allowed to overlap. If the eyelids are not involved the eyes are covered with black paper or cotton to prevent an ultraviolet conjunctivitis. If the eyelids are involved the patient is instructed to keep his eyes closed during the treatment. Moist packs are prohibited for from twelve to twenty-four hours after the treatment, as they interefere with the proper development of the erythema. Usually no packs are necessary. If the skin feels stiff after the erythema develops, a little petrolatum may be applied to relieve it. If the lesion spreads, the same or an even heavier dose of ultraviolet is given the next day. Most of the patients remark about the relief of pain, which often occurs while the lamp is still being applied. Later there is some increased edema of both the area of erysipelas and the surrounding normal skin. This subsides in from twenty-four to forty-eight hours, and if no further spread or complications occur the temperature drops rapidly to normal, the treated area wrinkles and then desquamates, and in five or six days the entire area is replaced with new skin. In the majority of cases only one treatment is necessary. A comparison of the three series shows that the average number of treatments per case (from 1.3 to 2.06) and the average number of days (from 3.13 to 4.58) from treatment to normal temperatures are nearly the same in the three series. The percentage of deaths (7.4) is much greater in the Minneapolis series than in the others (2.4 and 2). It is probable that this can be explained by the fact that Titus and Jenkins' patients were largely private cases, while the author's series was composed entirely of charity patients, many of whom waited until the last moment before allowing themselves to be taken to a hospital. Eighteen of the deaths occurred in cases in which some factor other than erysipelas was the primary cause of death. The greatest value of ultraviolet is shown in the treatment of erysipelas in infants. Erysipelas has always been feared as an extremely fatal disease in small children. Of fifteen children less than one year of age treated with ultraviolet radiation, only two died. To this may be added three private cases without a death.

Medical Diathermy

Council on Physical Therapy, J. A. M. A., 112: 20: 2046, May 20, 1939.

Medical diathermy is the therapeutic use of heat generated in the body tissues by a high frequency current which has insufficient local intensity to produce temperatures high enough to destroy the tissues or impair their vitality. Such currents are applied locally by three methods: (1) conventional long wave diathermy, contact metal electrodes being used, (2) short wave diathermy with an electric field, air-speed or insulated electrodes being used, and (3) short wave diathermy with an electromagnetic field method, a cable being used.

Contraindications

It is important to keep the contraindications for diathermy in mind. The local application of high frequency currents is contraindicated in the case of certain acute inflammatory processes, such as acute non-draining cellulitis and acute infectious arthritis, or any condition in which there is a tendency to hemorrhage, such as a gastric ulcer; over areas in which the appreciation of heat has been impaired or lost, as in the case of certain peripheral nerve injuries; through the abdomen, pelvis or lower part of the back during pregnancy; during menstruation or thirty-six hours before or after menstruation, and over areas where a malignant growth is suspected.

The use of medical diathermy in the following conditions is discussed: contusions, muscle strains, myositis ossificans, sprains and dislocations, bursitis, tenosynovitis, chronic arthritis, myositis and myofascitis, fibrositis, fractures, epididymitis and prostatis, bronchitis, pneumonia, acute enteritis, spastic colitis and simple catarrhal jaundice, inflammation of peripheral nerves, acute and chronic sinusitis, chronic keratitis, neuralgia, herpes zoster and iritis.

So far as competent investigators have been able to determine, there is no demonstrable selective thermal action in the living body. The Council has accepted certain short wave apparatus, which are listed in a booklet "Apparatus Accepted by the Council on Physical Therapy of the American Medical Association." Physicians are urged to read this booklet before purchasing an apparatus. The Council requires certain definite tests for deep heating before accepting an apparatus, and its survey of the machine gives the results of these tests as well as the efficiency and accepted technics for use of the machine.

Clinical observations, however, have not in-

dicated that the penetration of heat induced by short wave diathermy presents advantages not obtained by conventional diathermy. In the light of present observations, no specific physiologic effects other than those attributable to heating have been substantiated. The consensus (particularly of those who have performed careful experiments) would seem to be that the effect of various wavelengths between 3 and 30 meters is approximately the same. There are apparently no specific bactericidal effects other than those attributable to heat, either in vitro or in vivo. There is no reason to believe that treatments of five minutes or less have any marked action other than a psychic one.

The Post-Operative Treatment of Abdominal Conditions by Breathing Exercises and General Strengthening Exercise

E. M. Stephens, T.M.M.G. In Guy's Hospital Gazette, LIII:1328:199, June 17, 1939.

It is possible and not difficult to learn to breathe more with one part of the thorax than another. Controlled breathing may be mainly upper intercostal or lower intercostal or diaphragmatic in localization. When first attempting to do localized breathing a certain amount of concentration is necessary. This always proves rather difficult and tiring to a patient the day after the operation if there has been no pre-operative instruction. Ideally it would be well for all patients to be taught localized breathing before the operation, so that as soon as possible the patient can breathe to the maximum advantage. It may be necessary to use carbon dioxide to obtain deeper respiration.

The advantages of localized breathing, when it is impossible to use the whole thorax to its maximum capacity, are:

(a) Congestion in the lungs is prevented.
(b) The venous return to the heart is maintained, so minimizing the danger of thrombosis.

The combination of easy arm movements with the respiratory exercises helps to obtain a greater chest expansion. In order to produce this effect the best exercises are those in which the arms are raised to shoulder level or higher during inspiration and lowered on expiration.

The early use of breathing exercises is especially successful with timid patients, who are often so frightened by the wound which is present that they are unwilling to move or breathe deeply for fear of increasing pain.

Tendon Injuries: Their Classification and Early Treatment

David Goldblatt, M. D., F. A. C. S., New York City. In Am. J. Surg., XLIV:3:557, June 1939.

Postoperative Treatment. Supervised gentle and purposeful early active movements of the fingers are begun within forty-eight hours after the operation, while the muscles are relaxed in splintage. The movements should be done under the direction of the surgeon and are carried out by having the patient move both hands simultaneously. Cautious but complete excursions in flexion and extension of the fingers are carried through several phases and repeated twice a day. We find that by coordinated action of both hands in unison, the act, being purposeful, becomes easier. In this we agree with Harmer who advocates early supervised motion following repair of tendons without neural involvement. No force is exerted upon the tendons before the third week, and when instituted, it is done slowly and carefully.

This early motion has a dual effect—it prevents agglutination between tendon and tendon sheaths, obviating the formation of later adhesions, and the tension exerted upon the suture line stimulates the early formation of a callus weld. It also tends to lessen the period of splintage, maintaining muscle tonus, and restoring early function. The average period of splintage in this series of cases was ten days.

This series of cases confirms the greater relative incidence of tendon injuries in the male, the proportion being about six to one. In the lower extremities, the quadriceps extensor tendon, the tendo Achillis, and the patellas tendons lead in the order mentioned.

Of the flexor tendons, the flexor sublimis, profundus digitorum and palmaris longus lead, in the order given, while the extensor communis digitorum, indices and long extensor of the thumb lead in frequency, in the order given, among the extensor tendons.

Early preliminary preoperative relaxation by splintage is important in facilitating and obtaining a good repair, while early regulated supervised postoperative motion of the fingers (forty-eight hours postoperative) is essential in obtaining functional restoration of hand.

The index finger, thumb, and middle fingers are the important digits. One must always try to save the outer side of the hand where the severity of the injury demands sacrificing

parts of this important human tool. However, in the foot, one attempts to spare the inner side, this being the more important functional part of that member.

Patience is the keynote in treating tendon injuries; patience in evaluating the amount of damage present; patience in repairing the damage wrought, and patience in restoring functionally what one has restored surgically.

Lactic Acid Production During Rest and After Exercise in Subjects with Various Types of Heart Disease with Special Reference to Congenital Heart Disease

Philip Hallock. In. J. Clin. Invest., XVIII: 4: 385, July 1939.

The blood lactic acid studies of Hallock show that tissue anoxia is not present at rest in patients with congenital heart disease, either in the presence or absence of cyanosis. Following mild exercise there is a definitely abnormal rise of blood lactic acid in the cyanotic group of congenital heart disease, indicating a greater liability to the development of tissue oxygen deficit after even slight physical exertion. The presence of cyanosis and polycythemia in congenital heart disease does not necessarily indicate that oxygen deficit will develop following mild exertion for no significant rise of lactic acid level occurred in a case of morbus caeruleus. Following mild exertion, a definitely abnormal rise may occur in some acyanotic cases of congenital heart disease but the rise is not as great on the average as in the cyanotic group.

When dyspnea follows mild exercise the presence of tissue oxygen want may be assumed to be present regardless of what specific cardiac defect is ultimately responsible.

Book Reviews

INFECTIONS OF THE HAND. A GUIDE TO THE SURGICAL TREATMENT OF ACUTE AND CHRONIC SUPPURATIVE PROCESSES IN THE FINGERS, HAND AND FOREARM. By Allen B. Kanavel, M.D., Sc.D., Late Professor of Surgery, Northwestern University Medical School, Chicago; Attending Surgeon, Wesley Memorial and Passavant Memorial Hospitals, Chicago. Seventh edition. Cloth. Price, $6.00. Pp. 503, with 229 illustrations. Philadelphia: Lea and Febiger, 1939.

The last task which Doctor Kanavel accomplished before his sudden and tragic death on May 27, 1938, was the preparation of this seventh edition of his monograph on infections of the hand. Doctor Kanavel was one of the world's authorities on this subject. He believed that the after-treatment of patients suffering from injuries and infections of the hand frequently is so neglected or is carried out in such a haphazard manner that the ultimate results fall far short of what might be attained. He also believed that of equal importance with the proper methods of surgical treatment was a comprehensive knowledge of physical and occupational therapy necessary to bring about a restoration of function after the infection has been controlled.

The following chapters should be read by every physical therapist: function of the hand in relation to infection; general principles of treatment; physical therapy after infections of the hand; and the use of splints after infections of the hand. This monograph is the most authoritative and comprehensive work on infections of the hand and should be in the library of everyone interested in physical therapy in traumatic surgery.

RHEUMATISM. By Bertram S. Nisse, M.D., London; M. R. C. P., England, Hon. Physician, British Red Cross Clinic for Rheumatism, London. Cloth. Price 5s. Pp. 168. London: John Bale Medical Publications, Ltd., 1938.

This monograph is written for the general practitioner to describe the main features of the various rheumatic diseases. It is divided into three parts. Part one discusses rheumatic fever. The second section describes the various forms of fibrositis. Rheumatoid arthritis, osteoarthritis, menopausal arthritis and gout are considered in the third section. An excellent survey has been made of the therapeutic methods employed in the treatment of chronic arthritis. Without being too dogmatic the author gives indications of their value. The measures available for the general practitioner are considered more fully than those requiring elaborate apparatus and complicated technique. It can be recommended to the physician seeking guidance in the treatment of chronic rheumatism.

THE THYROID AND ITS DISEASES. By J. H. Means, M.D., Jackson Professor of Clinical Medicine, Harvard University, Boston. Being an Account Based in Large Measure on the Experience Gained in the Thyroid Clinic of the Massachusetts General Hospital. Cloth. Price, $6.00. *Pp.* 602, *with* 73 *illustrations. Philadelphia, Montreal and London: J. B. Lippincott Company,* 1937.

The thyroid gland has long been recognized as playing a most important role in health and disease. By virtue of its own hormone secretions and by its relation to other members of the endocrine chain it deserves ample consideration. The present volume is a splendid answer to this need. In it may be found an up-to-date presentation of the anatomy, physiology, chemistry and pathology of the thyroid gland. The text is based primarily upon abundant material studied at the Thyroid Clinic of the Massachusetts General Hospital. The case reports and illustrations are indeed excellent. It stresses diagnosis and treatment and consequently is most valuable for the practitioner and student.

GOULD'S POCKET PRONOUNCING MEDICAL DICTIONARY OF THE PRINCIPAL WORDS USED IN MEDICINE AND THE COLLATERAL SCIENCES WITH AN APPENDIX CONTAINING COMPLETE TABLES OF THE ARTERIES, BONES, CHEMICAL ELEMENTS, HORMONES, MICRO-ORGANISMS, MUSCLES, NERVES, PREFIXES AND SUFFIXES, PHOBIA'S SIGNS AND SYMBOLS, ETC., ALSO A PHYSICIAN'S DOSE-LIST OF DRUGS WITH THEIR INCOMPATIBILITIES, AND A VETERINARY DOSE TABLE BOTH IN THE ENGLISH AND METRIC MEASURES, AND BASED UPON THE ELEVENTH REVISION U. S. PHARMACOPEIA. By the late George M. Gould, A. M., M. D. Revised by C. V. Brownlow. Eleventh edition. Fabrikoid. Price, $2.00; *Thumb Index,* $2.50. *No pagination. Philadelphia: P. Blakiston's Son & Co., Inc.,* 1939.

This dictionary was published to meet the need for a small elementary word-book that could be slipped into the pocket. That it has been successful is shown by the facts that this is the seventy-fifth printing, the eleventh edition and that over 900,000 copies have been sold. It is highly recommended.

FROM HEAD TO FOOT. By Armitage Whitman, M.D. Cloth. Price, $2.50. *Pp.* 262. *New York and Toronto: Farrar & Rinehart, Inc.,* 1939.

This volume, by a well known orthopedic surgeon, was written for the layman and describes the achievements of orthopedic surgery. The author is associate professor of orthopedics at Columbia University and consulting orthopedic surgeon at the New York Hospital for the Ruptured and Crippled.

There are practical chapters on posture, the foot, bowlegs and knock knees, curvature of the spine, congenital deformities, infantile paralysis, influences of a handicap, spastic paralysis, fractures, osteomyelitis, injuries of the joints, tuberculosis of the bones and joints, low back pains, physical therapy, social service, workmen's compensation, veterans, and operations.

With the steadily increasing public interest in the crippled child and the injured adult, Doctor Whitman's book is an excellent contribution to provide information in a field where general knowledge of the laity is surprisingly meager.

THE FUNCTIONS OF HUMAN VOLUNTARY MUSCLES. By Norman D. Royle, M.D., Ch.M., F.R.A.C.S., Senior Orthopedic Surgeon, Lewisham Hospital, Sydney; Member of the British Orthopedic Association; Corresponding Member of the American Academy of Orthopedic Surgeons; Member of the International Orthopedic Society. Cloth. Price, 3s. 6d. *P.* 42, *with* 11 *illustrations. Sydney and London: Angus & Robertson, Limited,* 1938.

In the foreword of this small book A. N. Burkitt, professor of anatomy of the University of Sydney, states that Doctor Royle developed a remarkable voluntary control of individual muscles in his own body, being able, for instance, to contract the two bellies of the omohyoid muscle on one side, while the remainder of his neck muscles were partially relaxed. From his own experiences and clinical observations he presents this monograph on the action of individual muscles in the human body. It is a book that should be read by every physical therapist.

THE NEWER KNOWLEDGE OF NUTRITION. By E. V. McCollum, Ph. D., Sc. D., LL. D., Professor of Biochemistry, School of Hygiene and Public Health, the Johns Hopkins University, Baltimore, Elsa Orent-Keiles, Sc. D., Associate in Biochemistry, School of Hygiene and Public Health, the Johns Hopkins University, and Harry G. Day, Sc. D., Associate in Biochemistry, School of Hygiene and Public Health, the Johns Hopkins University. Fifth edition. Cloth. Price, $4.50. *Pp.* 701. *New York: The Macmillan Company,* 1939.

This is the fifth edition of this book since 1918. This volume has been completely rewritten, but the plan of it is essentially the same as that of the previous editions. The first two chapters are mainly historical and trace the developments of the modern concepts of nutrition. The next chapters consider the influence of the following elements in nutrition: carbohydrates, lipids, proteins, aminoacids, calcium, phosphorus, magnesium, sodium, potassium and chlorine. There are also chapters on iron, copper and nutritional anemias; iodine and its relation to thyroid function, and "trace" inorganic elements. Twelve chapters are devoted to discussions of the vitamins. Following this there are considerations of the dietary properties of foodstuffs, appetite normal and perverted, dietary habits of man in different parts of the world, diet in relation to the teeth and diet in relation to longevity.

This volume presents a concise survey of the field of nutrition which is more extensive and more inclusive than any other now available. It gives carefully selected references to the literature on this subject for the benefit of those who care to extend their reading to the original literature. It can be recommended as an authoritative source of material for those interested in a knowledge of nutrition.

DOCTORS, NURSES AND DICKENS. By Robert D. Neely of the Omaha Bar. Cloth. Price, $1.50. *Pp.* 153, *with* 3 *illustrations. Boston: The Christopher Publishing House,* 1939.

The thoughts recorded by Esther Summerson, the heroine of Dickens' "Bleak House," show in what high regard this author held the medical profession.

"I never walk out with my husband, but I hear the people bless him. I never go into a house of any degree, but I hear his praises, or see them in grateful eyes. I never lie down at night, but I know that in the course of that day he has alleviated pain, and soothed some fellow creature in the time of need. I know that from the beds of those who were past recovery, thanks have often, often gone up in the last hour, for his patient ministration. Is not this to be rich?"

Dickens portrayed life as he saw it on every side of him. Someone has aptly described his gift as that of "photographic exaggeration." Because human nature is the same today as it was then, Dickens' writings are in no sense outmoded. Neely has selected many interesting descriptions of the physicians and nurses that Dickens has made immortal.

This book is recommended to the followers of Dickens because Mr. Neely has given added interest and life to those outstanding characters who have become so familiar to all readers.

THE PSYCHOLOGY OF EARLY GROWTH, INCLUDING NORMS OF INFANT BEHAVIOR AND A METHOD OF GENETIC ANALYSIS. By Arnold Gesell, Ph.D., M.D., Sc.D., Director of the Clinic of Child Development and Professor of Child Hygiene in Yale University, and Helen Thompson, Ph.D., Research Associate in Biometry, The Yale Clinic of Child Development. Assisted by Catherine Strunk Amatrude, M. D., Research Pediatrist, The Yale Clinic of Child Development. Cloth. Price, $4.00. *Pp.* 290, *with* 30 *illustrations. New York: The Macmillan Company,* 1938.

This is another excellent monograph which has come out of the Yale studies of infancy. The present volume deals particularly with the biometric aspects of infant development. Recognizing the many factors at play in determining growth and behavior the authors have attempted to measure and give appropriate value to some of them. By this approach they hope to arrive at certain laws whereby predictions as to diagnosis and prognosis may be available. The book is replete with charts and appendices—a wealth of material for those particularly interested in biometrics.

CARDIOVASCULAR DISEASE IN GENERAL PRACTICE. By Terence East, M.A., M.D., F.R.C.P. (Lond.), Physician and Physician in Charge of Cardiological Department, King's College Hospital; Physician Woolwich War Memorial Hospital; sometime Examiner in Pathology, Conjoint Board; and Radcliffe Traveling Fellow, Oxford University. Cloth. Price, $3.50. Pp. 206, with 43 illustrations. Philadelphia: P. Blakiston's Son & Co., Inc., 1939.

The author states that in this book he has tried to keep in mind the difficulties which his hospital and private practice have shown him are met by general practitioners, and to show how one can overcome them by the simple means of clinical medicine. A glance through the table of contents will show that the author has accomplished his purpose. There are chapters on the interpretation of symptoms; the physical examination of the heart; heart failure; the treatment of heart failure; failure of the coronary circulation; failure of the peripheral circulation; rheumatic heart disease; subacute bacterial endocarditis, cardiovascular syphilis; chronic valvular disease; pericarditis; hypertension; thyrotoxicosis; auricular fibrillation and flutter; ectopic disorders of rhythm; disorders of conduction; the cardiovascular system in anemia, chronic pulmonary disease, chronic renal disease, minor infections, anesthesia, pregnancy and athletics; diseases of arteries and veins; congenital diseases of the heart; the heart in middle age and onwards, and some aberrations and the normal heart.

It is of interest to physical therapists to note that in convalescence from heart failure East recommends the use of massage and exercises. He gives a detailed list of the recommended exercises. The book can be recommended to the general practitioner.

THE SCIENCE AND ART OF JOINT MANIPULATION. By James Mennell, M.A., M.D., B.C. (Cantab.), Consulting Physical Therapist, St. Thomas' Hospital, and Lecturer, Massage Training School (London). Vol. I, The Extremities. Cloth. Price, $4.50. Pp. 233, with 284 illustrations. Philadelphia: P. Blakiston's Son & Co., Inc., 1939.

Mennell believes that to understand manipulation it is necessary to study afresh the articular facets between the various joints of the body and the physiological movements of the joints. He has done this for the joints of the extremities by many x-ray photographs and line drawings.

In his first three chapters the author presents many ingenious arguments on a certain type of joint lesion which he designates as a "locked joint." This is described as a derangement of physiological function caused by the application of some external force, and it may be a displacement so small as to be indistinguishable on x-ray examination. In these conditions manipulation is required to restore normal anatomical relationship and the normal physiological degree of movement.

Mennell believes that there is no justification for looking askance at manipulative treatment because fantastic claims have been, and still are, made for it. These claims certainly are built on a basis of error. The error, however, as he shows, often is in the diagnosis rather than in the treatment. This volume indicates that joint manipulation is a potent agent for good in a wide range of cases with a disordered function without gross displacement of a joint and without a condition covered by the word "arthritis" as that word is generally understood. It can be recommended to those studying joint motion and manipulation.

TEXTBOOK OF NEURO-ANATOMY AND THE SENSE ORGANS. By O. Larsell, Ph.D., Professor of Anatomy, University of Oregon Medical School, Portland. Cloth. Price, $6.00. Pp. 343, with 232 illustrations. New York and London: D. Appleton-Century Company, Incorporated, 1939.

The anatomy of the nervous system is a subject which is notoriously difficult for the medical student. Any text which can simplify even the least bit the complex structure of the brain, spinal cord and peripheral nervous system is indeed welcome. This book is an attempt in this direction. Throughout the book function is correlated with anatomy which usually makes more understandable material which otherwise may be considered very "dry." Frequent references to comparative anatomy likewise is helpful in aiding this understanding of structure and function. Special attention has been given the sense organs, a division of the nervous system in which the author has been particularly interested. The book is highly recommended as a text for the student.

INFRA-RED IRRADIATION. By William Beaumont, M. R. C. S., L. R. C. P., Physician in Charge, Physical Therapy Department, Westminster Hospital, London. With a foreword by Lord Horder, K. C. V. O. Second edition. Fabrikoid. Price, 6s, 6d. Pp. 159, with 26 illustrations. London: H. K. Lewis & Co., Ltd., 1939.

This is a monograph on infra-red irradiation. There are excellent chapters on the physical basis of infra-red irradiation, its physiological effects and the technique. The chapter on apparatus describes and illustrates only generators made in Europe. In his chapters on the treatment of some common symptoms and the application of infra-red irradiation to disease the author emphasizes that infra-red is not a panacea for all ailments, and that there are many conditions where a combination of treatments is essential.

DOCTOR—HERE'S YOUR HAT! THE AUTOBIOGRAPHY OF A FAMILY DOCTOR. By Joseph A. Jerger, M.D. Cloth. Price, $2.75. Pp. 279. New York: Prentice-Hall, Inc., 1939.

This is an interesting story of a family physician whose experiences literally take you around the world. There are many entertaining stories of experiences as an interne in a large hospital, as an assistant to a Middle Western small town physician and as a family physician in Chicago.

The continuity and interest of the story frequently is interrupted and spoiled by preaching of the author's belief that the well-loved family physician is indispensable to the community and to the nation, but that he is being "given his hat" by superspecialism of modern medicine.

DER MUSKELRHEUMATISMUS. Von Professor Dr. Max Lange, Krankenhaus Rotes Kreuz, München. Paper. Price, R.M. 4.50. Pp. 84, with 20 illustrations. Dresden and Leipzig: Theodor Steinkopff, 1939.

This is the fifteenth of a series of monographs on rheumatism edited by Professor Dr. Rudolf Jürgens, Stellv. Director der Universitätsklinik für natürliche Heil- und Lebensweisen und Chefarzt des Augusta-Hospitals, Berlin. Lange classifies muscular rheumatism as infectious and noninfectious and devotes the first chapter to the consideration of these conditions. In the second chapter he considers the importance of palpation in the diagnosis of this condition, and describes and illustrates the usual areas of muscle induration in muscular rheumatism. The remaining chapters discuss the diagnosis and treatment of this condition. Lange believes that in the treatment of muscular rheumatism massage is excellent. He devotes considerable space to the technique of massage as used in muscular rheumatism.

ANATOMY OF THE HUMAN LYMPHATIC SYSTEM. By H. Rouviere, Professor of Anatomy at the Medical Faculty of Paris, France. A Compendium translated from the original "Anatomie des lymphatiques de l'homme" and rearranged for the use of students and practitioners. By M. J. Tobias, Assistant Radiologist, Montefiore Hospital, New York. Cloth. Price, $4.00. Pp. 318, with 129 illustrations. Ann Arbor, Michigan: Edwards Brothers, Inc., 1938.

A knowledge of the anatomy of the human lymphatic system is of great value to the physical therapist. One of the physiologic effects of massage is to increase the lymphatic circulation. But massage may be harmful in certain swellings of the lymph nodes. It is of importance to be able to translate the significance of a node or swelling, or pain arising in a patient, often occurring in regions of the body where, for want of accurate information on the subject, lymph nodes are not even suspected.

The author calls attention to several instances where lymph node swelling may cause conditions which the physical therapist may be asked to treat. An acute or chronic inflammation of the subtrapezius nodes may cause torticollis. Inflammation of the superficial occipital nodes may lead to neuralgia or neuritis of the great occipital nerve. The appearance of an enlarged lymph node frequently offers the first clue to the existence or extension of a malignancy. There are many instances where this knowledge of the lymphatic chains and paths and the organs they drain may lead to the diagnosis of some deepseated abscess.

This volume is printed by photo-lithograph from typescript. This process is used by these publishers to make the publication of technical books in small editions pay for themselves. It can be recommended to physical therapists as an excellent reference book for information on this subject.

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